CHRONIC BRONCHITIS

By

TREVOR H. HOWELL, M R C P Ed

PHYSICIAN, GERIATRIC RESEARCH UNIT, ST JOHN'S HOSPITAL, BATTERSEA, CONSULTING PHYSICIAN, BERMONDSEY MEDICAL MISSION HOSPITAL, LECTURER IN PROBLEMS OF OLD AGE, ST BARTHOLOMEW'S HOSPITAL, LONDON

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PREFACE

THE first idea of this book was conceived when I was a general practitioner, seeing many patients who sought relief for their coughs and their wheezing My lack of knowledge about chronic bronchitis led me to keep records of my cases for further study More clinical material was added during war time experience at the Royal Hospital, Chelsea, and in India Thanks to the generosity of the Nuffield Foundation and the London County Council, I was provided with a research grant which allowed me to continue my investigations after demobilization This work was started as clinical assistant at the Brompton Hospital under Dr Lee Lander and continued at St John's Hospital, Battersea

My grateful thanks are due to Dr A P Piggot for his help with the sections of this book dealing with morbid anatomy, also to Sister Dodman of St John s Hospital, whose charts of sputum measurements have been invaluable

I hope that this attempt to give a new account of a very common, every day disease will not be entirely lacking in interest

T H H

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Germany Writing in 1792, he states· *Peripneumonia notha fortior nobis bronchiorum catarrhus est, quo in pituitosis obesis senibus cachectis laxis hominibus, frigida et humida sub tempestate, ab accedente membrane mucosa hos canales investientis irritatione, copiosior tenaxque pituita celeriori passu secreta bronchiorum fines opplendo, suffocationem sat cito minitatur, quin ob dolorem aut ob primariam inflammationem spiritus praecludatur*

The term bronchitis, however, was first used by Charles Badham, Physician to the Westminster General Dispensary, in 1808 His book *Observations on the Inflammatory Affections of the Mucous Membranes of the Bronchiae* is still the classic

ment mention most of the drugs in use today, with many shrewd remarks on the indications for their use This little book, which can quite easily be carried in the pocket, has only one serious omission There is no mention of the cardiac sequelae of bronchitis In most other respects it is superior to the recent accounts of bronchitis found in medical text books

The publication of *De l'auscultation mediate*, by Laennec in 1819, saw the next great advance in the description and classification of the bronchial diseases This author mentions chronic mucous catarrh, chronic pituitous catarrh, suffocative catarrh and dry catarrh as the chronic affections of the bronchial tubes]He is the first to describe bronchiectasis as a separate entity Both clinical and pathological findings are given in the account of these diseases, together with some personal experiences in therapeutics Laennec, however, does not give prominence to the later cardiac complications of emphysema and bronchitis, which are now commonly termed chronic cor pulmonale We shall return to the descriptions given by this author when discussing the clinical varieties and morbid anatomy of the disease

One of the best accounts of bronchitis by a British author is that of John Mackintosh, of Edinburgh The second edition of his *Elements of Pathology and Practice of Physic*, published in

1831, mentions the fact that chronic bronchitis frequently co-exists with diseases of the heart, and is a cause of dropsical affections He also states that Morgagni and Valsalva were well acquainted with the phenomena of this disease His description of the morbid anatomy is excellent and includes a discussion of the mechanism of bronchial spasm which is in advance of its time Apart from this Scotsman, [most medical authors followed closely in the steps of Laennec So marked was this tendency that Sir Thomas Watson considers in his lectures of 1848, that the majority of writers have trodden with too submissive reverence in his footsteps He goes on to say "There are by no means such differences in the symptoms or in the proper treatment of the several varieties of chronic inflammation of the membrane in question, as to make these numerous subdivisions of any practical utility" He then lays down the principle that the symptoms of chronic bronchitis are cough some shortness of breath and expectoration of altered mucus This agrees closely with the opinion of Stokes in his book on diseases of the chest published a few years before (1837)]

The clinical lectures of Graves, also published in 1848, do not refer to Laennec, but are of a strictly practical nature, paying much attention to aetiology, climate, occupation of the patient and what would now be termed social medicine The next author to make an interesting contribution was Daniel Maclachlan, Physician to the Royal Hospital, Chelsea He gives an excellent account of the natural history of the disease as seen in elderly patients and he agrees with Watson on the unimportance of the appearance of the sputum His description of the complications and the morbid anatomy are an advance on his predecessors The portrait which he gave may still be perused with profit by modern physicians A study of chronic bronchitis among Chelsea Pensioners during the years 1940–44 only confirmed the findings [illegible] ghty years before [illegible] analysis of the symptoma- [illegible] the Royal [illegible] rst [illegible] the [illegible] Hospital for Diseases [illegible] published in 1866, discusses the mechan[illegible] the significance of family importance of post nasal catarrh,

CHAPTER II

THE BACKGROUND OF THE DISEASE

CHRONIC bronchitis is one of the most common diseases in this

remarkable that little attention has been paid to this condition either by the medical profession or by the public As a drain on public funds, chronic bronchitis comes second only to fibrositis in its importance The loss of working time, cost of medical treatment and sickness benefit mount up to a considerable sum each year In addition, the effects of prolonged ill-health and the tendency to premature death make this disease one of the major socio-medical problems in this country today As W A Lister has said "If one consults the text-books on this subject

the very existence of the disease others consider it a symptom-complex produced by a variety of distant pathological factors with a common end-result Since it seems to be such an important condition, let us pass on to review its frequency, distribution and aetiology, as much as possible in a factual manner

Frequency

Among the working classes in this country, diseases of the respiratory tract are more common than any other group of illnesses This was first remarked by Calvert Holland in 1843 and was confirmed by Pemberton in 1949, both surveys taking place in Sheffield According to the latter, bronchitis accounts for more than 30 per cent of the total respiratory maladies Evans has drawn attention to the frequency of chronic bronchitis in Liverpool and Roper considers that the morbidity and mortality

underlying condition, usually cardiac Lister thinks that most patients with chronic bronchitis are really suffering from a mild degree of asthma, while Christopher attributes the condition to autonomic imbalance Several American writers describe an entity which they call "sino bronchitis" and which seems to be nothing more than chronic sinusitis It has been said, even in England, ' if the condition of the upper respiratory tract be attended to, the lower will look after itself " One of the standard medical text books mentions the aftermath of acute bronchitis, climate, latitude, fatigue, privation cold, wet, fog deformities of the chest chronic cardio renal disease and upper respiratory tract diseases with mouth breathing as being the main predisposing factors To this, Tidy adds excessive smoking and Livingstone dust, fumes, hypertension, gout and alcoholism Leonard Williams has, perhaps, the most interesting suggestion "Chronic bronchitis with its accompanying emphysema is a disease on which a good deal of wholly unmerited sympathy is frequently wasted It is a disease of the gluttonous bibulous, otiose and obese and represents a well deserved Nemesis for these unlovely indulgences the majority of cases are un doubtedly due to surfeit and self indulgence "

West goes into rather more detail on the point of aetiology than do most writers He quotes experiments by Lauder Brunton on the effects of cold, mentions the influence of the seasons geography, race, age, sex, irritating dusts and inheritance eventually discusses the bacteriology and considers the effects of venous congestion as a possible contribution Some of these factors have been investigated by the writer in a series of patients under his control, others have been discussed in recent medical publications The results of these researches may be compared with the opinions quoted above

Upper respiratory infection

It has been customary for a specialist in diseases of the ear, nose and throat to examine all cases of chronic bronchitis attend ing my out patient clinic or admitted to my wards during the past two years Out of 42 such patients only 5 have shown any sinusitis On the other hand, when a series of 53 cases were

given a questionnaire including enquiry into coryza, nasal block and sore throats, the incidence of positive answers was much greater Some 44 per cent stated that they often had colds in the head and 22 per cent that they did so occasionally Only 34 per cent considered that they had colds rarely As regards blockage of the nose, 43 per cent considered that it was often in that state, 21 per cent thought that this was unusual and 36 per cent were blocked sometimes When questioned as to the likelihood of a cold in the head going down on to the chest, 65 per cent stated that this was customary with them, 28 per cent said that it did not do so and 7 per cent that it might occur There was considerable diversity of opinion as to the factors which precipitated catching cold Cold weather itself was the

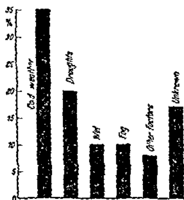


FIG 1 —Factors in onset of coryza

favourite, followed by draughts, wet, fogs, unpleasant smells, east winds and so on Some 17 per cent could not attribute their coryza to any known factor (Fig 1) When asked about the frequency of hoarseness and sore throats, it was found that the latter was never a complaint and the former only in 14 per cent These figures do not go far to support chronic upper respiratory tract infection as a cause of chronic bronchitis, however much they may indicate a lowered resistance to organisms in the cases concerned

Previous diseases

When asked about past illness before the onset of bronchitis, some 32 per cent of the series claimed to have been previously healthy, and 42 per cent had never suffered from any disease affecting the respiratory tract A previous attack of bronchitis had occurred in 14 per cent and the same number remembered having had pneumonia Influenza was mentioned in only 8 per cent, while 12 per cent had suffered from other respiratory infections of some kind, usually pulmonary tuberculosis As regards childhood, 77 per cent had no history of chest trouble, but 20 per cent remembered having bronchitis and 3 per cent some other respiratory tract illness The results of enquiry about coryza in childhood were unsatisfactory

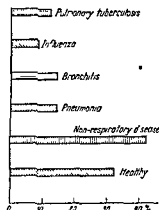


FIG 2 —Previous diseases

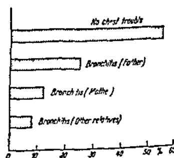


FIG 3 —Family history

Family history

There was a history of bronchitis in some close relative in 45 per cent of the patients In 25 per cent the father was affected and in 12 per cent the mother Other chest trouble had been present in 11 per cent of the fathers and 8 per cent of the mothers while 12 per cent of brothers and sisters had suffered from pulmonary tuberculosis, but only 8 per cent from bronchitis Some 40 per cent of the mothers and 28 per cent of the fathers

of these patients had been completely healthy as far as could be remembered The incidence of other diseases was mainly either cardiac or cancer in so far as it was known Only one man in the series had both mother and father suffering from bronchitis

Occupation

This did not seem to have much influence upon the onset of the disease Most of the cases (77 per cent) had been employed indoors during their working life and the remainder did not seem to have been unduly exposed to inclement weather When asked about dust in their occupation, 40 per cent stated that they had been in contact with it and 60 per cent did not think so Since some of those who gave positive answers were window cleaners, clerks and housewives, it is difficult to know how much notice to take of their replies

Geography

Chronic bronchitis is a disease with a definite distribution in the world Countries with a dry atmosphere, such as the middle parts of the United States of America, seem to be relatively free Those climates with a high uniform temperature, together with a low dew point also see little of it North western Europe is the place in which it is most common, but any climate showing violent temperature changes, moist atmosphere and cold raw winds will favour the occurrence of the disease It is necessary

hospitals One of these was a British Military Hospital, where almost every case labelled "bronchitis" showed wheezing as its main feature Almost all of these cleared up the moment they were transferred from a dry dusty station to one where there was some atmospheric moisture At the Indian Military Hospital, the bronchitic patients were of a different type, feeble, undersized, coughing and spitting but not usually wheezing Most of them remained unfit for further military service whatever treatment was adopted

Season

In this country, chronic bronchitis is most prevalent in the late winter and spring This is borne out by the mortality figures of the Registrar-General (Table II)

TABLE II

Monthly Deaths from Chronic Bronchitis in 1946

Month	Males	Females	Total	Percentage
January	2,133	1,241	3,374	19
February	1,301	771	2,072	12
March	1,579	806	2,385	14
April	875	445	1,320	8
May	713	325	1,038	6
June	571	317	888	5
July	497	234	731	4
August	482	182	664	3
September	474	228	702	4
October	568	255	823	5
November	904	460	1,364	8
December	1,368	667	2 035	12
	11 465	5,931	17,396	100

Fog

It has been shown by Breen and Benjamin that the morbidity and mortality from respiratory diseases in London is closely related to the presence and duration of fog In particular, a combination of fog with low temperatures is likely to cause a high death rate Evidence to support this is also forthcoming from American sources It would seem as if the mucous membrane of the respiratory tract has its resistance to infection lowered by the impact of cold, damp, foggy air This was borne out in my experience among the Chelsea pensioners, as mentioned elsewhere in this book

Sex

[illegible]

This bears out the clinical impression gained at the Bermondsey Medical Mission Hospital for Women and Children that chronic bronchitis is not among the major problems encountered there.

Degenerative changes

Some authors consider that chronic bronchitis is evidence of certain degenerative changes in the body Lord, for instance, having had 161 subjects of the disease examined *post mortem*, found advanced cardiovascular changes in 103 of them (63 per cent) He stated that seven out of nine cases with regular winter cough showed "arteriosclerosis of the aorta, valvular disease of the heart or chronic nephritis" as the probable cause When we consider the age at which this disease is most common, and still more, the age at which patients often die with it or its complications, then we see how necessary it is to take into account the various changes in the body which accompany advancing years Atheroma of the aorta and coronary arteries is not unusual among subjects of sixty or seventy Thickening of the edges of valve cusps is common at this age Changes in renal structure are not unexpected among the elderly, even those who have no cough The weight of evidence seems to be against the hypothesis of Lord

Yet, in past descriptions of bronchitis and in previous discussions of its aetiology, sufficient notice has not been taken [illegible] would permit the establishment and encourage the continuation of a chronic cough

Nose Atrophy of the mucosa

Lungs Decline in efficiency of bronchial eliminative mechanism, including cilia and smooth muscle
Sclerotic changes in bronchi, connective tissue and blood vessels, diminishing normal movement
Degenerative changes in the pulmonary vascular bed
Decline in efficiency of nervous mechanism in the lungs
Diminished effectiveness of lymphatic drainage
Reduction of vital capacity
Impairment of activity in the reticulo endothelial system

Thorax Atrophy of mucosa and lymphoid tissue in pharynx and trachea
Rigidity of chest wall, calcification of cartilages
Weakening of respiratory muscles, descent of the diaphragm
General deterioration of circulatory efficiency

General Diminished immunity values
Impaired regulation of temperature
Decline in efficiency of other parts of the body

Consideration of this list will show how accumulation of sputum, epithelial changes, altered irritability of the mucosa and diminished effectiveness of cough may be brought about by the mechanisms enumerated When we add weakening of thoracic muscles, impaired defence organization and lowering of resistance to certain bacterial flora, some of the phenomena customary in chronic bronchitis are easier to comprehend The explanation of the temporary successes from penicillin aerosols and the disappointing subsequent relapses becomes more obvious if we take infection to be a secondary factor, not a primary one Similarly the results which follow administration of "expec-

many of the known facts about the disease and is therefore worth entertaining in the sphere of aetiology

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CHAPTER III

MORBID ANATOMY

History

THE FIRST account of the morbid anatomy of chronic bronchitis is said to have been given by Morgagni, after dissecting a subject suspected of phthisis in whom no tubercles were found Badham describes the post-mortem appearances of several cases as far as the lungs are concerned, but makes no mention of the other organs Laennec is obviously familiar with the

Gairdner mentions bronchial obstruction by swollen mucous membrane, atelectasis, atrophy of the lung, emphysema, cica-

scientific classification of pulmonary disease have resulted in the removal of certain features which he included The illustrations of Hamilton and Ziegler towards the end of the last century remain the best up to date, as the accounts in modern text-books are generally poorer than those of their predecessors

Present material

The present study of morbid anatomy in chronic bronchitis is based on the results of post-mortem examination in 300 subjects, all carried out by Dr A P Piggot, at St James' Hospital, Balham, or St John's Hospital, Battersea, London The age and sex incidence is shown in Table III below As may be seen, there are few cases under the age of fifty who have come to

half the number in the ninth decade This makes an interesting comparison with the figures of the Registrar-General given in an earlier chapter

TABLE III

Age and Sex of Autopsy Subjects with Chronic Bronchitis

Age Group	*Males*	*Females*	*Total Cases*	*Percentage Female*
20–29	3	1	4	
30–39	8	2	10	14
40–49	20	2	22	
50–59	42	14	56	25
60 69	54	23	77	30
70–79	53	37	90	41
80 89	20	20	40	50
90–99	1	—	1	—
	201	99	300	33

The criteria by which these subjects were selected was, first, that they were known to have had a chronic cough during life As far as morbid anatomy was concerned, the presence of muco-pus or pus in the bronchial tree with signs of inflammation in the mucous membrane was taken as the characteristic feature for selection Gr [illegible] were excluded, but a few cases [illegible] presented clinically as s [illegible] included Where there was only mucus in the bronchi and the reddening of the lining seemed due to venous congestion rather than inflammation, the case was not accepted As will be seen from Table IV, a few subjects in whom chronic bronchitis was co-existent with another, more fatal, disease have been included in the series Patients who had their chest trouble as a minor incident, however, have generally been omitted This disposed of patients who died from new growths in caecum, prostate, bladder and stomach, disseminated sclerosis and cerebral vascular lesions, gastric ulcers and intestinal diverticuli which had

perforated into the peritoneal cavity—all of whom had an incidental chronic bronchitis

Causes of death

By far the commonest cause of death in the cases reviewed was congestive heart failure (right ventricular failure) This accounted for a third of the subjects Next came chronic bronchitis itself, without any other obvious fatal complications in just under a quarter of those examined Broncho-pneumonia accounted for about a fifth of the deaths The remaining cardiac lesions, such as left ventricular failure with pulmonary oedema, and myocardial degeneration were next on the list After these followed acute bronchitis, bronchiectasis and a number of incidental causes of death, not intimately related to the original disease These results are expressed in Table IV

TABLE IV

Causes of Death in Chronic Bronchitis, at Autopsy

Lesion	*Number*	*Percentage*
Right ventricular failure	98	33
Chronic bronchitis alone	69	23
Broncho-pneumonia	57	19
Acute bronchitis	20	7
Myocardial degeneration	18	6
Left ventricular failure	15	5
Cardiovascular degeneration	9	3
Bronchiectasis (5) Pyonephrosis (2) Spontaneous pneumothorax (2) Coronary thrombosis Aortic valvular disease Spontaneous rupture of right ventricle Empyema Acute pancreatitis	14	4
Total	300	100

Appearance of the lungs

The characteristic finding at autopsy in cases of chronic bronchitis is the presence of muco pus or pus in the bronchial tubes Sometimes the whole bronchial tree is filled, down to the smallest branches, so that the cut surface of the lung will become speckled with little yellow blobs when squeezed In other cases, only the lower or smaller bronchi contain this kind of exudate Mucus alone may be found in cases of pulmonary congestion, so that this condition must not be mistaken for bronchitis The appearance of the mucous membrane varies somewhat in different subjects Some cases show a rather shaggy or velvety lining to their bronchial tubes, while others seem to have a sparse or meagre inner coat At times the longitudinal striations are marked, but more often they are inconspicuous The colour of the mucosa varies, but is basically red When inflammation is present only in the smaller tubes, the upper reaches of the bronchial tree are striped pink between white cartilages, resembling the triangles on a backgammon board In other subjects, alternate bands of pink and red, or lighter and darker red, are seen in the larger tubes, recalling the stripes of a tiger Often the red colour is more uniform in its distribution and may be tinctured with cyanotic purple to a greater or less degree in the lower or posterior branches One or two cases, however, show a pearly white appearance in the larger tubes

As far as the substance of the lung is concerned, some degree of emphysema is almost universal In the series under review, atrophic emphysema was found in 13 per cent, mainly among those aged over 70 A slight degree of hypertrophic emphysema was seen in 22 per cent, moderate change in 52 per cent and marked severe emphysema in 13 per cent, with large bullae or blebs at the free edges of the lungs It is interesting to think that several cases in which the radiological appearances suggested that bullae were present had none at autopsy, the converse was, of course, often true We can compare the findings on emphysema with those in a series of 926 patients over the age of 65 dying from various conditions Here atrophic changes were commoner than hypertrophic changes in all cases aged more than 82, but below this age the proportion was reversed, until

at 75 hypertrophic emphysema amounted to three-quarters of the total The work of Macklin and Macklin suggests that atrophic changes are associated with sclerosis which results in central rigidity at the root of the lung and immobility of the tubes Hypertrophic changes are due to damage to elastic tissue which prevents recoil and favours over-distension In [illegible]

The heart

The commonest cardiac abnormality in the series of autopsies was dilatation of the right ventricle, either alone (36 per cent) or combined with some degree of hypertrophy (29 per cent) Pure hypertrophy was present to a slight degree in 6 per cent, to a moderate degree in 3 per cent and to a considerable degree in 2 per cent The latter group represented typical specimens of chronic cor pulmonale On the left side of the heart, the ven- [illegible] cases (20 per [illegible] nt There was [illegible] pertrophy and dilatation in 4 per cent of the series As regards the myocardium, it was soft, friable and easy to shred between the fingers in 19 per cent of the subjects, fibroid in 7 per cent, fatty in 4 per cent and showed scars of past infarcts in 4 per cent There was typical brown atrophy in 3 per cent, while one case (0 3 per cent) had a rupture of the right ventricle When the aorta was examined, it was completely free from atheroma in 6 per cent Some 22 per cent showed slight atheromatous change, 34 per cent moderate atheroma and 27 per cent much atheroma with calcification The coronary arteries were free from atheroma in 11 per cent, had slight changes in 11 per cent, moderate atheroma in 43 per cent and calcification in 35 per cent, in 110 cases on whom a special note was made Most were aged over 60

Other organs

Most of the organs showed some degree of congestion. This was most marked in the liver, where it was found in 83 per cent

of the subjects The spleen was congested in 59 per cent, the kidneys in 56 per cent and the stomach in 33 per cent of cases in this series The remaining organs showed no constant or characteristic change

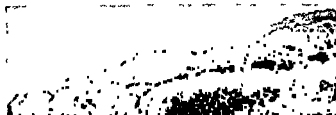
TABLE V

Morbid Changes found with Chronic Bronchitis

	Percentage
Lungs	
Atrophic emphysema	13
Slight hypertrophic emphysema	22
Moderate " " with blebs	52
Marked "	13
Dilated bronchi	15
Pulmonary oedema	34
Consolidation	31
Apical scars	10
Fibrosis of lung	20
Pulmonary collapse, one or more lobes	4
Heart	
Right ventricle dilated	36
" " hypertrophied	11
" " dilated and hypertrophied	29
Left ventricle dilated	15
" " hypertrophied	26
Other organs	
Liver congested	83
Spleen congested	59
Kidney congested	56
Stomach congested	33

Histology

The normal human bronchi are lined by columnar ciliated epithelium, except for the terminal branches which have squamous non-ciliated cells The epithelium is several cells



(*a*) Chronic bronchitis with spasm showing absent epithelium thickening of basement membrane and hypertrophy of muscles



(*b*) Acute exacerbation of bronchitis with epithelium being shed Haemorrhage and infiltration by leucocytes



(*c*) Normal bronchus in a woman of 93 Showing calcification of the cartilage and mucous glands both active and resting

PLATE I

[*To face page* 24

deep, the lower or deeper cells appearing rounded or cubical in shape These lie on a basement membrane (Debove's membrane) External to this is a loose vascular areolar tissue—the corium of the mucosa Threaded through the deeper parts of this are elastic tissue together with longitudinal and circular

bronchial cartilages are strands of deep fibrous tissue, while externally some lymphoid tissue may be present at times The cartilage is absent in the smaller bronchial tubes and the various layers may be difficult to distinguish In later life the cartilage tends to become calcified and to stain darkly

In chronic bronchitis, the morbid processes may produce changes and alterations in many of these structures Part, or all, of the columnar ciliated epithelial lining may be shed into the lumen, together with mucus, leucocytes and even red corpuscles, forming the sputum If the detachment of epithelium is incomplete, the cells from the deeper layers remain in clumps on the basement membrane This gives the appearance which is interpreted as "columnar cells being replaced by low cuboidal or flattened epithelium" As a rule, the whole epithelium is not shed together at one time for if sections containing several bronchi are cut and examined, some will be almost denuded while others have a normal lining

The basement membrane also varies in appearance It is often quite normal, but at times it seems thickened or even oedematous When the inflammatory processes are marked, there may be actual ulceration through the membrane with the formation of a kind of granulation tissue in places The corium is usually congested in chronic bronchitis, showing a number of dilated capillaries There may be collections of leucocytes near the surface or small haemorrhages may be found either superficially or in the deeper layers The mucous glands generally show proliferation or hypertrophy, growing much more extensive and bulging along beneath the cartilages The acini are usually large, thin walled and full of secretion Sometimes, however, parts of the gland show acini which stain deeply and have thick

walls Occasionally there may be small groups of round cells or lymphocytes around the glands or their ducts When there has been considerable inflammation and much cellular infiltration of the submucosa, there is a tendency for the muscle and elastic tissue to diminish or even to disappear and be replaced by fibrosis On the other hand, where the patient has been subject to frequent attacks of bronchial spasm during life, the muscle is often thick and well marked The majority of sections show an increase in the amount of fibrous tissue present, what ever the state of the muscle The cartilage is not usually altered except by the appearance of calcification in some of the older subjects Peri-bronchial tissues do not show much change as a rule, but occasionally either inflammatory changes or some degree of fibrosis may be found around the smaller tubes

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CHAPTER IV

SYMPTOMS

Cough

CHRONIC bronchitis is a disease with few symptoms These are cough with expectoration and dyspnoea Since the cough usually precedes the dyspnoea by three or four years, according to Dobell, we may take it as the primary factor in the symptomatology In the early stages of the disease there is merely a winter cough lasting perhaps a week or so each year Later, the duration grows longer and the amount of sputum expectorated increases The cough is troublesome in the early morning on rising, until the secretion accumulated during the night has been removed It may then give little trouble until bedtime, when it disturbs the rest during the early part of the night Osler described this as a variable cough, changing with the seasons Some patients, however, reach a stage in which they cough incessantly, disturbing the rest of those around them and bringing up copious quantities of sputum Sudden changes in air temperature, exposure to cold or damp, irritating dusts or gases, over-exertion, even loud talking and laughing may be followed by a paroxysm of coughing Those who are familiar with the works of Herbert Jenkins will remember his character Mrs Hearty, who was always reduced to a state of cough, wheezing and dyspnoea by her strong sense of humour On the other hand, warm weather and a suitable climate will sometimes cause the cough to vanish, at least for a time

When I was Deputy Physician and Surgeon at the Royal Hospital, Chelsea, during the war, the commonest disease among Chelsea pensioners was chronic bronchitis The infirmary contained a dozen or more well-marked examples of the disease every winter as soon as fogs started to come up from the neighbouring river Thames During the summer of 1941, the hospital was damaged by enemy action and it became necessary to transfer the infirmary to Ascott House in Buckinghamshire

The first patients to be collected in the new infirmary were the regular cases of bronchitis It was found, however, that these men did not suffer much from the disease in their new surroundings, but if discharged back to Chelsea during the winter, their cough returned within a few days

In order to investigate the symptomatology of chronic bronchitis, I drew up a questionnaire to be filled in by a series of patients This was based, in part, on that of Dobell Some 53 forms were returned in a state which was suitable for analysis As regards cough, enquiry was made as to duration, mode of original onset, frequency, periods of freedom, and the factors which might make the cough worse or better The results of this survey give some quantitative values as to the various points in the history of patients with the disease All cases where the diagnosis was in doubt were excluded, but three subjects were found to have a small group of dilated bronchi at autopsy, after being included in the series

It was interesting to find that many of the subjects were somewhat uncertain about the period since the onset of their cough Only 6 per cent thought that it was less than two years, while 26 per cent put it between two and five years Some 18 per

ject to a cough The longest history known to the writer v that of a Chelsea pensioner aged 87, whose army reco mentioned chronic bronchitis more than forty years previou A duration of twenty years is not at all uncommon, and n be taken as about the natural life of the disease in those in wh no complications have arisen

The mode of onset varied considerably in different patien No less than 34 per cent of the series could not recollect h their cough started, and in 19 per cent the disease had aris gradually, by almost imperceptible stages An infection of t upper respiratory tract was the precipitating factor in or 11 per cent and an acute attack of bronchitis in 6 per cen Some of the patients attributed their disease to service in t war of 1914–18 Hence exposure in the field was blamed as *fo*

et origo mali in 10 per cent, and poison gas in 8 per cent Only 3 per cent considered that contact with dust or sand played any part, while in 6 per cent the disease had made its appearance after some illness not affecting the respiratory tract (Fig 5)

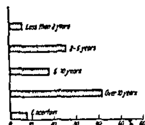


Fig 4 —Duration of bronchitis

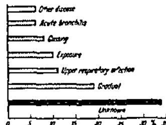


Fig 5 —Factors in onset

When considering the frequency of cough at the time of enquiry, 21 per cent stated that they did not cough very much On the other hand, a quarter of the patients complained of a constant cough throughout the whole day Nocturnal exacerbations were mentioned in 21 per cent and morning bouts in 17 per cent, while variations in the weather were claimed to affect the frequency in 17 per cent This statistical distribution is interesting to compare with the standard description given earlier in this chapter In order to elucidate this point, patients were asked whether they ever had periods of freedom from cough The answers varied considerably Over half the cases (51 per cent) admitted that they were sometimes quite free Over a third (38 per cent) stated that they were never without a cough Variations in the weather were associated with exacerbations or remissions in 11 per cent (Figs 6 and 7) Quite a number of factors were associated with an exacerbation of the cough The commonest was cold air (36 per cent), then came fog or exertion (17 per cent) each, smoke (15 per cent), wet weather (11 per cent) and dust (10 per cent) Several patients (23 per cent) could not put a finger on any definite circumstance which made their cough worse The same variation of opinion was demonstrated when consideration of beneficial factors arose

Cough mixtures gave most relief in 38 per cent, while just over a quarter (28 per cent) only improved in dry weather Warmth was specifically mentioned as helpful in 19 per cent while just under a quarter of those questioned were uncertain about any

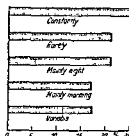


FIG 6 —Frequency of cough

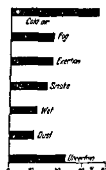


FIG 7 —Exacerbations of cough

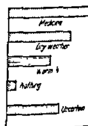


FIG 8 —Factors diminishing cough

[illegible] (4 per cent) said [illegible] ards the [illegible] equally divided There was a large proportion who found that any great exertion brought on a bout of coughing

The facts mentioned above should be considered in relation ship to the known mechanism and purpose of coughing It is well known that cough can be initiated through reflex action, volition, habit or any combination of these The reflex may be set up by stimulation of the larynx, the tracheo bronchial mucosa the pleura or the diaphragm, while Dobell describes a cough originating in the ear Generally the reflex is started when the secretion of mucus to the ciliated lining of the bronchi is changed from its normal viscosity, according to Jacobs The result of this change is cough, one of the most protective of reflex actions The patient takes a deep breath, the glottis closes while the thoracic wall descends and becomes fixed Then the glottis opens, the diaphragm rises like a plunger, counter acting the force exerted by the abdominal muscles The air, which has been under high pressure within the thorax is

suddenly released and sweeps forcibly up through the trachea and larynx This action assists the regulatory self-cleansing of the bronchial tree

It has been said that an early morning cough suggests overnight collection of mucus or muco pus from sinusitis All cases of chronic bronchitis were therefore examined by a specialist in diseases of the ear, nose and throat and an x ray was taken of their sinuses Among the cases included in this series, only two showed evidence of sinusitis It would seem, therefore, as if early morning cough can arise in simple chronic bronchitis merely from accumulation of secretion within the bronchial tree Jacobs states that cough appearing on exertion points to myocardial weakness and passive congestion of the lungs In view of the fact that 80 per cent of the patients who filled in the questionnaire stated that cough followed exertion, this needs consideration Horder and Gow mention cough following effort in cardiac failure They consider that the cough is purposeless, it is not referable to any pulmonary cause, it ceases with rest Since the cough of chronic bronchitis does not fulfil these criteria, its occurrence on exertion does not necessarily mean myocardial weakness Nevertheless the sequence exertion -cough-wheezing is common both to bronchitis and cardiac insufficiency, and must therefore be borne in mind when assessing the fitness of a patient

Dyspnoea

In the series of patients who answered the questionnaire, there was only one who stated that he was not short of breath Some 20 per cent had suffered from dyspnoea less than two years and the same proportion from two to three years In 32 per cent dyspnoea had been present more than three years but less than ten, while 28 per cent had been short of breath for more than ten years When asked about the number of stairs which they could mount without distress, 15 per cent claimed that a single upward tread made them gasp Most of these patients were partly or completely bed ridden The same number stated that they could not manage more than five stairs without a rest, while 23 per cent could mount between five and

control of the respiratory centre, situated in the medulla near the calamus scriptorius This is composed of several parts It is connected with the motor neurones of the phrenic and intercostal nerves in the cervical and upper thoracic segments of the cord,

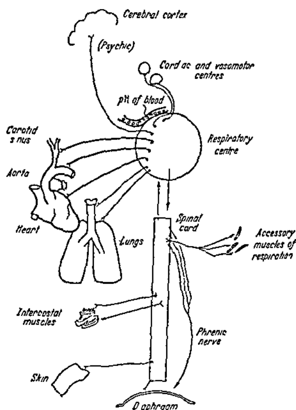


Fig 11 —Mechanism of dyspnoea (after Best and Taylor)

by descending tracts There are also connexions with the larynx and accessory muscles of respiration Impulses pass to the centre from the cerebral cortex, the carotid sinus, the aorta, the larynx, trachea and other parts of the pulmonary organs, as well as from skin, intercostal and abdominal muscles There are

probably stimuli from higher cardiac and vasomotor centres in the brain (Fig 11)

The respiratory centre is very sensitive to changes in the partial pressure of carbon dioxide in capillary blood A small increase may be enough to double the depth of respiration as well as to quicken the rate The actual stimulating factor is probably not carbon dioxide itself, but the change in hydrogen ion concentration Thus states of acidosis can produce overbreathing and alkalosis may produce shallow apnoeic types of respiration Oxygen lack is to some extent a stimulant of the respiratory centre, but much less so than alteration in hydrogen ion concentration It has been suggested that anoxia acts on respiration through the carotid sinus and not directly States of increased metabolism, such as great exertion or exophthalmic goitre, probably produce dyspnoea chiefly by accumulation of acid metabolites Other factors, however, are known to play a part One of these is vital capacity The closer the depth of breathing approaches the vital capacity of the individual, the greater is the subjective discomfort which is experienced Anything which lowers vital capacity tends to produce easy discomfort on breathing Hence advanced pulmonary emphysema is a potent factor in causing shortness of breath among bronchitic patients As Christie has pointed out, the sufferers from this disease cough and strain their alveolar walls many times a day over a period of years cutting down considerably the surface available for respiratory exchange of gases There is gross [illegible]

gaseous acidosis occurs

As we have seen above, more than three-quarters of those who answered the questionnaire stated that they suffered from wheezing This complication plays a significant part in the production of dyspnoea According to Rubin there is rapid accumulation of secretion and an associated swelling of the bronchial mucosa in certain types of bronchitis These give rise to severe expiratory dyspnoea, wheezing and explosive cough Later there is secondary infection of the sputum with consequent

fever and purulent expectoration In advanced cases there may be patches of atelectasis in the affected lung due to blockage of bronchi by spasm and accumulated viscid secretion

In pensioner H P, aged 80, was admitted to the infirmary of the Royal Hospital, Chelsea, on November 6, 1941, wheezing loudly He had been coughing for two weeks and had started to wheeze the previous day He was flushed, distressed and dyspnoeic with a temperature of 100 4° F On auscultation, nothing could be heard in the lungs but loud sonorous rhonchi and sibili He was given 0 5 ml adrenaline immediately and again in six hours time The next morning there was no pyrexia, the wheezing had diminished very considerably, and the man was no longer distressed This cycle of bronchial spasm and pyrexia was repeated six times within the next two years It always responded more quickly to adrenaline than to any other form of treatment, even administration of sulphonamides

Many cases of bronchitis appear to have an asthmatic element in their essence There is a well known asthma-emphysema-chronic bronchitis sequence and also a bronchitis-emphysema-asthma progression This may be related to autonomic nerve factors The smooth muscle of the bronchus receives dilator fibres from the sympathetic and constrictor fibres through the vagus nerves These come from the anterior and posterior pulmonary nerve plexuses, which are intimately related with the cardiac pl[illegible] that these neural factors are o[illegible] influence i[illegible] is most marked in chronic bronchitis, causing relaxation and favouring dilatation of the bronchial tubes It is also known that histamine causes intense bronchial constriction This may be produced locally by the infective elements and thus give rise to a vicious circle As a matter of experience, certain patients with spasmodic bronchitis seem to respond better to antihistamine drugs than to other modes of treatment

Mr B was a patient at St John's Hospital, Battersea Formerly a butcher, he found that each visit to the refrigerating chamber brought on an attack of cough and dyspnoea Later, he developed an intractable bronchial spasm nearly every day

for about nine months of the year Stramonium was useless, ephedrine gave little relief, aminophylline helped him for a time When a capsule of 50 mg of Benadryl (Parke Davis) was administered, however, he obtained great relief and remained free from wheezing for most of the day At post mortem examination a small group of terminal bronchi were found to be dilated, like fingers of a glove, and contained pockets of pus

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CHAPTER V

PHYSICAL SIGNS

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tardy step they enter, puffing and panting, scant of breath, which makes speech difficult, while a significant shake of the head often tells more eloquently than words of the inward discomfort, and that the breathing is embarrassed Words they avoid, for the entrance of air often provokes a paroxysm of coughing, and this causes them much distress. They excite one's compassion, albeit they occupy a great deal of time to little effect; for they are apt to be stupid and to comprehend badly . " A few pages further on, his description continues "The patient is scant of breath at the best of times, and therefore is distressed by any exertion Consequently, he avoids effort. The gait is slow and the step measured To miss a step, or to place the foot on anything which might slip, might involve an effort which would be painful An attitude of watchfulness is maintained which is in time so pronounced as to be noticeable If [illegible]

preparatory to speech"

This description, of course, applies to the advanced stages of the disease, when emphysema is well developed and cyanosis is probably present By this time, there is an increased antero-posterior diameter of the chest, with prominent clavicles, rounded shoulders, wide intercostal spaces, increased subcostal angle and prominent angle of Louis The thorax is fixed in the inspiratory position, the sternoclavicular and trapezius muscles are hypertrophied, while dilated vessels may be seen on the lower part of the thorax The fingers are often, but not always,

If the patients continue in this state for long, they become pyrexial The findings in the chest remain those of bronchitis, but radiologically signs of consolidation are seen The clinical signature of pneumonia may not appear for 24 or 48 hours afterwards These unrecognized pneumonias, which masquerade as bronchitis, are not uncommon and sometimes terminate life unexpectedly by their effect on the cardiovascular system Certain cases present bronchial spasm as their main feature Some of these have known precipitating factors such as cold, fog or dust which are sure to produce rhonchi and sibili These may be alone and unattended as in true asthma, but are more commonly accompanied by a few moist sounds As a rule these patients are apyrexial and have a normal pulse rate Once the spasm is relieved, there is freer expectoration and the sufferer is no longer distressed

Cardiovascular system

As we have noted above, the cardiac impulse is often impossible to see in cases of chronic bronchitis On the other hand, an epigastric pulsation is frequently present This is usually taken to indicate hypertrophy of the right ventricle On palpation, the apex beat is either not felt or is difficult to localize When much emphysema is present, the attempt to percuss the area of cardiac dullness is valueless, as previously mentioned Auscultation reveals little apart from heart sounds which are more distant than normal Towards the later stages of the disease, the second pulmonary sound may be accentuated In patients with a high blood pressure, however, the second aortic sound is likely to be the louder Authorities differ somewhat on this question of the blood pressure in chronic bronchitis Steel considers that it is apt to be low or normal Hatch states that it is normal with a low diastolic figure Sandberg claims that it resembles that of the corresponding age group, neither a particular rise nor fall being demonstrable He fails to find any remarkable number of arteriosclerotic changes It should be remembered, however, that the blood pressure is liable to considerable variation in subjects of chronic bronchitis As the disease progresses, myocardial weakness tends to make an insidious appearance with a

lowering of the systolic figure During acute exacerbations of the condition there is a fall in the blood pressure which rises again on recovery A few patients show wide variations even when their disease remains dormant All these must therefore be taken into consideration when this matter is discussed

Chelsea pensioner No 197, aged 84, was a regular sufferer from chronic bronchitis During health his blood pressure had been 180/95 mm, but fell to 160/80 when admitted to the infirmary with bronchitis in February 1942 A year later, during a subsequent attack, the figure fell to 140/70 but rose to 150/75 when fit for discharge from hospital In December 1943, following another bout of the disease he became mentally confused In this phase he resisted any attempt at examination and the blood pressure reading in this condition gave a figure of 200/150 mm

Tables VI and VII give a comparison of the blood pressures of two series of patients with chronic bronchitis, one being composed of Chelsea pensioners and the other of ordinary civilian patients

TABLE VI

Blood Pressure in Civilian Cases of Chronic Bronchitis

Age	No	Under 120 mm	120–160 mm	160–200 mm	Over 210 mm
30-39	2	0	2	0	0
40-49	13	1	4	7	1
50-59	11	0	6	4	1
60-69	11	0	2	5	4
70 79	24	0	4	13	7
80-89	10	0	0	2	8
	71	1	18 (25%)	31 (44%)	21 (30%)

With regard to arterial thickening, there does not seem to be any great deviation from the normal In a combined series of 106 cases, including both civilian patients and Chelsea pensioners, 13 had arteries which were not thickened, 22 had slight

TABLE VII

Blood Pressure in Chelsea Pensioners with Chronic Bronchitis

Age	No	Under 120 mm	120–160 mm	160–200 mm.	Over 200 mm
60–69	7	0	3	3	1
70–79	35	1	15	11	8
80–89	15	0	3	8	4
90 99	1	0	0	1	0
	58	1 (2%)	21 (35%)	23 (40%)	13 (24%)

thickening, 46 had moderate thickening, 19 had tortuosity and thickening, 6 had radial calcification This is what might be expected of any random sample with a similar age grouping It may be compared with the author's figures for healthy old men, which differ little from the above

The electrocardiogram in chronic bronchitis has few, if any special characteristics In patients with hypertension there is usually left axis deviation, those with chronic cor pulmonale have right sided preponderance The later stages of the disease may be associated with low voltage, and the tendency to left axis deviation is often less than the blood pressure figure migh lead one to suspect Many cases show a curve which is withi normal limits for the age of the patient

X-ray appearances

As Sparks and Wood have pointed out 'The clinical di nosis of chronic bronchitis and emphysema is often easily m and confirmed by the physical examination The aid of radiol is not called in except to exclude other diseases such as pu monary tuberculosis or neoplasm" Most of the radiological signs found are those indicating emphysema These are increased clarity of the lung fields, lowering of the diaphragm, widening of the costo phrenic angle, increased intercostal spaces with more horizontal ribs, enlargement of the retrosternal space



(*a*) Chronic bronchitis marked emphysema unfolding aorta



(*b*) Active tuberculosis clinically mistaken for chronic bronchitis

PLATE II



(c) Chronic bronch tis emphysema old fibrosis at apex

Three special sign are described Williams's sign consists of limited excursion of the diaphragm Staehelin's sign is the paradoxical movement of the diaphragm on deep inspiration There is absence of Sinnhula's sign, so that no clear space is seen between the heart and diaphragm in full inspiration In some cases of emphysema, localized areas of increased translucency may be seen, usually at the bases of the lungs These are interpreted as emphysematous bullae by some radiologists, but the diagnosis cannot always gain confirmation at autopsy

With Lipiodol, the outline of the bronchi is often beaded and irregular, showing uneven dilatations Some saccularity followed by constriction may also be seen Areas of the lung may show the presence of fine, thread like bronchi, not seen in a normal film These persist *post mortem* Trail also says that definite white streaks may be seen along the lines of affected bronchi, continuing more clearly and further than any normal striations

In mild or early cases, there may be no abnormality at all in the x-ray Later on, patients with repeated attacks of bronchitis show striations radiating from the hilum of the lungs After a few years, they may assume the appearance of a ' moustache," drooping downwards towards both lung bases Enlarged hilar glands may be seen in a proportion of patients Sometimes the bronchial walls have a thickened or sclerotic appearance This change may also occur in elderly subjects who do not suffer from the disease When the disease is active, parts of the lung often show a mottled or ' fuzzy' marking on the film, which is thought to indicate excessive bronchial secretion These changes disappear as the clinical condition improves The cardiac shadow shows no characteristic abnormality in this disease Where systemic hypertension exists, a prominent left ventricle can be seen in the anteroposterior view Elderly patients usually show an unfolded aorta in the second oblique position, but some widening or tortuosity may be obvious even from in front Where there is pulmonary hypertension, the pulmonary conus is prominent and the right ventricle may show signs of enlargement Marked hilar congestion is often present in later stages of the disease There are often signs of past disease, such as apical fibrosis or pleural thickening

The value of radiology in chronic bronchitis to the clinician is twofold it excludes many conditions which must be considered in the differential diagnosis and it is a most valuable guide to the presence or absence of any complications Senile *phthisis* and carcinoma of the bronchus are diseases which can be readily misdiagnosed as chronic bronchitis on clinical grounds An x ray of the chest if taken as a routine will reveal at once the true state of affairs in the majority of cases So much of course, is obvious The commoner revelation is a hidden pneumonia, unsuspected by the clinician

Mr S, aged 60 was admitted to a mental observation ward because of peculiar behaviour at home On examination he showed signs of emphysema with many rhonchi and sibili all over the lungs There was no obvious pyrexia or tachycardia at rest An x ray of the chest revealed signs of consolidation at the left base which had not been detected clinically The appropriate treatment was instituted and the patient made an excellent recovery both physically and mentally

Those patients suffering from exacerbations of their chronic bronchitis need radiological examination at frequent intervals It is surprising how much the x ray picture can change in a short time without corresponding clinical alterations The onset of consolidation resolution collapse and so on often takes place without clear physical signs Hence when bronchitis is active, frequent visits to the x ray department are indicated

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CHAPTER VI

VARIETIES OF CHRONIC BRONCHITIS

When Badham originally described bronchitis in 1808, he distinguished three principal species by the epithets of "acuta," "asthenica" and "chronica" The second of these was the disease formerly bearing the name of "peripneumonia notha," while the third included the labels "chronic cough," "tussis cum dyspnoea," "catarrhus pituitosus" and "catarrh senilis" Laennec, in 1819, classified bronchitis by the nature of the sputum Hence he mentions "chronic mucous catarrh," "pituitous catarrh," "suffocative catarrh," "dry catarrh" and "latent catarrh" These terms have often been retained by later writers and the species "putrid bronchitis" and "plastic bronchitis" have been added to them Certain of these forms of the disease, such as the plastic variety, are extremely rare Others are probably not chronic bronchitis at all For example, Laennec's "suffocative catarrh" appears to be none other than oedema of the lung The description of "dry catarrh" might serve as an account of the cough associated with infection of the nasal sinuses 'Putrid bronchitis" nearly always turns out to be bronchiectasis at autopsy As Samuel West remarks, only one of Traube's cases was found *not* to have either cavities or gangrene of the lung In recent years, Burke recognized five varieties simple, asthmatic, spirochaetal, mycotic, and allergic Hatch, on the other hand, classifies cases as capillary, catarrhal, fibrinous or plastic mechanical, obliterans and putrid Gee mentioned phthinoid bronchitis, with wasting and abundant expectoration of purulent sputum It can be seen from this account how difficult the classification of the disease can be

In my experience, attempts to differentiate various species of the disease by the character of the sputum are not satisfactory If the results of expectoration be collected in a glass measuring

fine crepitant rales scattered through the chest on auscultation The sputum of such patients showed no tubercle bacilli on repeated culture and the x-ray picture did not indicate any lesion beyond bronchitis The original impression on a clinical observer was one of miliary tuberculosis, yet the subsequent course of the disease failed to support this This species of bronchitis in weedy, undernourished Indians was quite familiar to the radiologist attached to the hospital as something different from pulmonary tuberculosis But, as Gee says "The disease is nothing but bronchitis, yet the symptoms are those of phthisis pulmonalis" In this country, such cases are seen from time to time and usually occur in women Sometimes there is mental depression in addition to the physical changes, but this can be relieved by Dexedrine, while the cough and expectoration are resistant to any form of treatment

The essential characteristic of plastic bronchitis consists in the expectoration of fibrinous casts of the bronchial tubes after a paroxysm of more or less severe dyspnoea Apart from these bouts, the disease has the same symptoms as those of ordinary bronchitis The aetiology of the condition is unknown There is a tendency to collapse of the lung beyond the affected portion of bronchus and this may even become fibrotic While the cast is being formed, there is increasing dyspnoea until it has been expectorated, when the breathing is relieved The cough is paroxysmal and violent, often producing vomiting, epistaxis or haemoptysis There is no hoarseness or stridor, as in laryngeal obstruction The casts usually appear in the sputum as lumps or pellets, which expand in water to develop the typical branching form The casts consist of mucin and fibrin, they contain eosinophil cells and sometimes Charcot Leyden crystals Curschmann's spirals may be found The common organisms in the sputum of these patients are Friedlander's bacillus and pneumococci Some authorities stress the asthmatic type of the attacks of dyspnoea and the lack of response to adrenaline and atropine There may be some associated pyrexia In the later stage, when the cast is loosening, a flapping sound—*bruit de drapeau*—may be heard on auscultation over the affected part of the lung.

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The essential characteristic of plastic bronchitis consists in the expectoration of fibrinous casts of the bronchial tubes after a paroxysm of more or less severe dyspnoea Apart from these bouts, the disease has the same symptoms as those of ordinary bronchitis The aetiology of the condition is unknown There is a tendency to collapse of the lung beyond the affected portion of bronchus and this may even become fibrotic While the cast is being formed, there is increasing dyspnoea until it has been expectorated, when the breathing is relieved The cough is paroxysmal and violent, often producing vomiting, epistaxis or haemoptysis There is no hoarseness or stridor, as in laryngeal obstruction The casts usually appear in the sputum as lumps or pellets, which expand in water to develop the typical branching form The casts consist of mucin and fibrin, they contain eosinophil cells and sometimes Charcot-Leyden crystals Curschmann's spirals may be found The common organisms in the sputum of these patients are Friedlander's bacillus and pneumococci Some authorities stress the asthmatic type of the attack of dyspnoea and the lack of response to adrenaline and atro pine There may be some associated pyrexia In the later stag when the cast is loosening, a flapping sound—*bruit de drape* —may be heard on auscultation over the affected part of t lung.

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The differentiation between the two conditions rests mainly upon the clinical findings and the radiological appearances Of these, the latter is the more reliable, as exemplified elsewhere, under the chapter dealing with the pulmonary complications of the disease

In the field of public health and social medicine, it is not unusual to find a patient labelled "*chronic bronchitis*" who has infected one or more members of his family with pulmonary [illegible]

investigation of his disease in bad part, protesting against the interference with "his bronchitis" Some of these subjects masquerade clinically as unilateral bronchitis The writer has only seen one case in which true chronic bronchitis was confined to one lung

Chelsea pensioner, S, aged 68, had ten exacerbations of chronic bronchitis during the last five years of his life On each occasion, signs were much more marked in the left lung than in the right In between these acute episodes, there were no clinical signs on the right side Eventually he died in cardiac failure At autopsy there was no evidence of pulmonary tuberculosis seen by naked eye The left bronchial tree showed marked signs of chronic bronchitis, while the right had only minimal changes There was considerable emphysema

Carcinoma of the bronchus

In its early stages, this disease can simulate the clinical picture of chronic bronchitis It may also arise in a patient who is known to be a bronchitic subject, so that both diseases cohabit the body together I have records of 22 cases in which the double diagnosis was confirmed at autopsy by Dr A P Piggot, in a series of 300 examples of bronchial neoplasm (7 per cent) The symptoms are cough, dyspnoea, and stained sputum Recurrent pleural effusion can also occur Involvement of mediastinal glands or other sites by secondary deposits may give rise to signs and symptoms which are misleading An x-ray of the chest will usually furnish the information necessary to clinch the

diagnosis Cytological examination of the sputum is sometimes informative In doubtful cases, bronchoscopy is of assistance Removal of a portion of tissue for histological examination may be advisable if this latter procedure is carried out Lipiodol bronchography is another examination which furnishes information useful in establishing the differential diagnosis

Bronchiectasis

This condition is liable to be misdiagnosed as chronic bronchitis unless the help of radiology is available Persistent cough with copious expectoration, periodic haemoptysis pyrexial exacerbations, dyspnoea general toxaemia and wasting these make up the classical picture of the advanced stage of the disease In some cases, there is the *forme sèche haemoptoique* of the French writers without sputum normally but addicted to bouts of coughing up blood stained material at times The physical signs are usually basal they may be unilateral or bilateral In the areas affected there may be limitation of chest movement, altered vocal fremitus or diminished percussion note Breath sounds are often harsh and may be cavernous in type Coarse rales, with or without rhonchi and sibili are usual Clubbing of the fingers is usual but may be found in chronic bronchitis also The key to differential diagnosis is Lipiodol bronchography in every suspected case When the bronchial tree is adequately filled with opaque solution, it is easy to see whether the tubes are dilated or not There is however one group of patients in whom the dilatation is only of a temporary nature At one stage of the illness a bronchogram suggests some cylindrical dilatation Yet a second examination several months later shows bronchi of normal dimensions Finally there is a small group of cases whose course physical signs and history suggest bronchiectasis—yet neither bronchogram nor autopsy reveal dilated tubes These seem to be the bronchoblennorrhoea of West and others

Other conditions

The remaining diseases which may be mistaken for chronic bronchitis have more or less characteristic radiological

appearances The pneumoconioses, for instance, can show discrete nodular shadows, tending to uniformity, not more than 6 mm in diameter, with well defined borders surrounded by normal lung fields In asbestosis, there is a tendency to fine pulmonary fibrosis with a "ground glass" appearance A picture suggesting the spines of a porcupine may be found above the dia phragm Fungus infections of the lung frequently show radiating perivascular markings, going on to irregular or nodular areas of infiltration, chiefly in the lower lobes Diagnosis is established by the presence of the organism in the sputum Syphilis of the lung may show gummatous masses or a diffuse fibrosis The physical signs are generally much more marked than the symptoms There are usually other stigmata of the disease present, together with a strongly positive Wassermann reaction The pulmonary lesions resolve under anti syphilitic treatment

A certain number of cases labelled chronic bronchitis are *merely examples of pulmonary congestion* While cough and dyspnoea are present, the latter predominates On exertion wheezing makes its appearance, but is absent at rest The physical signs are confined to the lung bases where numerous moist crepitations may be heard The expectoration is composed of mucus, not muco pus, and is scanty The radiological appearances are those of basal or hilar congestion, not bronchitis

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CHAPTER VIII

CLINICAL PATHOLOGY

Sputum

CONSIDERABLE attention has often been paid to the characters of the sputum in chronic bronchitis Laennec founded his classification of the disease on the quantity and quality of the matter expectorated He states, "The quantity of the expectoration is more variable from day to day, but always greater than in the acute disease It not infrequently amounts to 1 or 2 lb in the course of the twenty-four hours It is increased on every fresh attack of cold " In another place, he says, 'The expectoration in the chronic stage is less glutinous, more opaque and nearly puriform Occasionally it is of a dirty greyish or greenish hue and in this state it cannot be distinguished from the expectoration of phthisis Sometimes, but rarely, it is tinged with blood It is usually inodorous, but sometimes becomes more or less foetid and assumes the smell as well as the other physical qualities of the different kinds of pus " Stokes mentioned five varieties of sputum when describing the character of the secretions First was transparent mucus, which was often tenacious in cases with an irritable cough Second came opaque mucus which was amorphous or sometimes moulded to the form of the tube Third came muco puriform secretion, fourth puriform, which was very rare in an unmixed state Last was serous secretion, about which he remarked that pituitous catarrh was rarely seen Stokes made one interesting observation on the sputum in bronchitis when he said, "The sooner we see opaque sputum appear, the sooner shall we observe the convalescence of the patient "

Sir James Mackenzie also mentions the variations in appearance in his book on symptoms "The character of the expectoration indicates its source," he claims, "a transparent and frothy expectoration coming from the upper air passage, while the more viscid comes from the lower or from near the alveoli, as

in the early stages of pneumonia, when it is usually stained more [illegible]

muco-purulent sputum is found in chronic bronchitis" Samuel Jones Gee, in his Lumleian Lectures, considers that the distinction of various types of sputum in chronic bronchitis is not of great value "How common it is to see mucous and purulent sputa in the same spitting pot, to see purulent sputa floating or lying in thin, transparent, colourless mucus, probably the different secretions come from different parts of the bronchial tract" He points out that the act of expectoration may differ in its results at different times of the day, so that the early morning specimen may be purulent, while only mucus is produced for the remainder of the twenty-four hours West, who was a colleague of Gee at Bart's, mentions that the sputum may be small in amount, but is often fairly abundant It is expectorated in lumps or mouthfuls, yellow and nummular, containing few, if [illegible] bronchitis [illegible] om [illegible] liva and air bubbles Panton and Marrack have little to add to this account forty years later They point out that an excess of epithelial cells denotes that the mouth and upper air passages are the source of the matter expectorated They find that pus cells are present in all sputa and consider that the presence of elastic fibres indicates that there has been actual destruction of lung tissue

Bacteriology

The early writers on bronchitis naturally had no knowledge of the part played by micro-organisms in the production of disease Even Sir William Gairdner, who died in 1907, makes no reference to bacteriology in his work on the pathology of bronchial disease West states that the bronchi in health contain many organisms, among them pneumococci, *B Friedlander*, *Streptococcus pyogenes*, *Staphylococcus albus* and *aureus* During an attack of bronchitis, these are increased in number

and other organisms, such as *B proteus*, *B typhosus*, *B coli* and moulds appear Among more recent writers, Marshall states that pneumococci, streptococci, *M catarrhalis* and *B Friedlander* may be found in the sputum of almost every case Young and Beaumont mention pneumococci, streptococci, *M catarrhalis*, *B Friedlander* and *Spirochaete bronchialis* Steele gives some comparative frequencies in a series of cases

M catarrhalis	68 per cent
Pneumococci	64 per cent
Streptococci	56 per cent
Gram positive cocci	40 per cent
Gram negative bacilli	8 per cent
B Friedlander	8 per cent
Diphtheroids	4 per cent

It will be seen from these figures that several organisms are present in most specimens of sputum Since bacteria can now be attacked with specific weapons, such as the sulphonamide drugs, penicillin, streptomycin and the other antibiotic preparations, the matter of the bacterial flora in the bronchial tree during bronchitis has become a matter of considerable importance If the disease is primarily an infection it should be possible to cure it or to improve it greatly by eliminating the noxious organisms On the other hand, if the removal of bacteria is not followed by clinical improvement, we must look elsewhere for the primary cause of the disease condition For this reason, a certain amount of attention was paid to the changes in flora found when a group of cases of chronic bronchitis were investigated over a period of several months The results of this investigation are described below

The first step was to have the sputum of 50 cases of chronic bronchitis examined bacteriologically The reports indicated that the majority of subjects had at least two organisms present, while more than half showed three. The results are indicated in Table VIII

A single examination, however, for each patient did not seem to give sufficient information Hence the bacteriology of the sputum in a number of patients was investigated at intervals

TABLE VIII

Relative Frequency of Organisms

Commonest	Per cent	Second (42)	Per cent	Third (28)	Per cent
M catarrhalis	32	M catarrhalis	36	M catarrhalis	
				Pneumococci	28
Streptococcus viridans	22	Streptococcus viridans	14	H influenzae	18
Pneumococcus	18	B Friedlander	14	Streptococcus viridans	14
B Friedlander	12	Pneumococci			
		H influenzae	9	Streptococcus haemolyticus	7
B coli					
Streptococcus haemolyticus	4	B coli			
		Staphylococcus alb	5	Sarcinae	4
B influenzae					
Staphylococcus alb		B proteus			
B proteus		Streptococcus haem			
Sarcinae	2	Sarcinae	1		

over a period of several months It was found that the flora varied somewhat from case to case when the results were examined in the aggregate For example, Mr F had 45 sputum examinations in 90 weeks Pneumococci were found on 40 occasions, *M catarrhalis* on 36, *B Friedlander* on 36 also and *H influenzae* 10 times At times various types of streptococci or staphylococci were also present Mr P, on the other hand, who had 49 sputum tests in 95 weeks, had *M catarrhalis* present 40 times, pneumococci 33 times, *H influenzae* 21 times, *B Friedlander* 13 times and *Streptococcus viridans* 11 times It was found that pneumococci were among the predominant organisms in 27 of the cases investigated They were the commonest finding in 38 per cent of the total cultures, second in 44 per cent, third in 15 per cent and fourth in 2 per cent, being found on 339 occasions all told *Micrococcus catarrhalis* was

present in 399 cultures being commonest in 55 per cent second in 38 per cent and third in 7 per cent among 26 patients *B Friedlander* was found in 24 of the series having a total of 205 cultures It was commonest in 43 per cent second in 34 per cent, third in 20 per cent and fourth in 3 per cent *Haemophilus influenzae* was grown 181 times in 18 cases In 22 per cent of these it was the commonest in 32 per cent second in 38 per cent third and in 3 per cent fourth Finally *Streptococcus viridans* was found 97 times among 20 patients It was commonest in 29 per cent of cultures second in 40 per cent third in 24 per cent and fourth in 7 per cent None of the other organisms attained the same frequency as these five

TABLE IX

Serial Frequency of Predominant Organisms

Organism	Cultures	Cases	Percentage First	Percentage Second	Percentage Third	Percentage Fourth
Pneumococci	339	27	38	44	15	2
M catarrhalis	399	26	55	38	7	—
B Friedlander	205	24	43	34	20	3
H influenzae	181	18	22	32	38	3
Streptococcus viridans	97	20	29	40	24	7

If the reports of sputum culture were scanned each week or each fortnight as they returned from the laboratory it was usually seen that the chief organism was not the same for long *M catarrhalis* might lead the field two or three times only to be replaced by pneumococci or *B Friedlander* after a short while The commonest bacteria of one culture often tended to sink to second or third place and then to emerge again a month or two later at the top Expectorant drugs did not appear to have any influence on the bacteriology while they were administered If coloured water was provided as a medicine the same tendency to periodic alterations was found over a period

extending to several months Sequences of one organism, such as *M catarrhalis* or *B Friedlander* were equally long or equally common whether water, a standard cough mixture or a series of different drugs was administered each week Of course penicillin would abolish sensitive bacteria for a time, but these would slowly creep in again and reach the top of the list within two or three weeks after cessation of the drug At times of acute exacerbations of chronic bronchitis, there seemed to be a tendency for certain penicillin sensitive organisms, such as pneumococci or streptococci to flourish If penicillin were then administered in the form of an aerosol, these bacteria would vanish from the sputum, leaving *B Friedlander* as the dominant, or sometimes the sole flora, in the majority of cases At the same time the total amount of sputum expectorated each day usually diminished considerably Yet the chronic aspects of the disease did not appear to be greatly affected by any such change in bacteriology So far, streptomycin and other antibiotics have not yet been used on these cases It is therefore not possible to confirm certain American accounts of substantial improvement in patients with chronic pulmonary suppuration when the bacteria of the respiratory tract are controlled by various mixtures

exacerbations The course of the disease does not appear to be altered in other ways, however, and the patients continue to be subject to the manifestations of chronic bronchitis

The blood

It is probable that the blood count and haemoglobin level in chronic bronchitis depend chiefly upon the degree of emphysema which is present Owing to the state of the alveoli, gaseous interchange between the blood and the air is not *easily or* efficiently effected, and a state of anoxic anoxaemia tends to be present in the later stages of the disease In order to compensate for this, the number of circulating red corpuscles increases so that there is a polycythaemia This is associated with a higher level of total haemoglobin in the blood Since the normal

mechanism of the Hamburger ionic interchange cannot work very well under conditions which limit the diffusion of oxygen into the pulmonary capillaries and the effusion of carbon dioxide into the alveolar air, the amount of reduced haemoglobin is raised When this reaches the absolute figure of 5 grammes per cent, clinical cyanosis occurs This state of anoxia and polycythaemia results in relative starvation of the peripheral tissues The state of the pulmonary circulation throws an added burden on to the right ventricle, with a consequent tendency to venous congestion Hence we get stagnant anoxia in addition to the anoxic form This again is associated with a greater accumulation of carbon dioxide so that a vicious circle is formed Such a state can only impair the efficiency of the myocardium and diminish still further the exchange of gases between the blood and the tissues As McMichael has shown, the circulation in emphysema tends to be rapid When the heart goes into congestive failure, it does so with a high cardiac output, and any form of treatment which lowers this causes rapid deterioration in the condition of the patient The only way in which the tissues can exist and function effectively is to have the blood, such as it is, circulating as rapidly as possible through them Hence there will be variations between the findings in cases of chronic bronchitis, depending upon the degree of emphysema present We may expect to find some cases with a raised haemoglobin, but some in whom it is normal There will be some subjects with a high blood count and others in whom the count is not raised These expectations agree quite well with the findings in a series of cases to be detailed below

This series was composed of 48 successive patients who presented themselves either in the wards or in out patient clinics The figures are taken from their initial blood count Twenty-two had a haemoglobin level over 100 per cent (Haldane) Most of these were men Twenty-six had a figure below 100 per cent and it is significant that 13 females, all the women save one, came into this group Since the cases were unselected, all degrees of emphysema were present The highest finding was 130 per cent in a man who died shortly afterwards with advanced cor pulmonale The lowest figure was 80 per cent which occurred

CHAPTER IX

PULMONARY COMPLICATIONS OF CHRONIC BRONCHITIS

Emphysema

SOME degree of emphysema is common among middle aged subjects and almost invariable in those who are over seventy As age increases, the proportion of the atrophic type rises so that only a small number of men or women over 90 years old show the hypertrophic variety A series of 25 cases in the tenth decade examined *post mortem* at St John's Hospital, Battersea,

of the hyper-
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lungs which are not truly due to his disease but are associated with the mere passage of time In those who are younger, a marked degree of hypertrophic emphysema is almost invariable, and blebs at the lung margins are quite common Some of this [illegible]

chronic bronchitic may cough many times a day over a period of years and this type of stress and strain might produce the loss of elasticity in alveolar walls The pleura and thoracic cage might suffer similar strain Bronchial spasm would add to this stress " The same writer goes on to point out how misleading the clinical signs can be Subjects having a barrel-shaped chest may show no emphysema *post mortem* Obliteration of cardiac dullness, diminished chest expansion, reduction of vital capacity and radiological appearances may all give some indication of the degree of emphysema present, but none is completely reliable Too much weight should not be placed on refinements of radiological diagnosis One patient, whose x-ray plates seemed to indicate the presence of emphysematous bullae at a certain

bronchitis the dilatation of the tubes may only be slight and temporary Later permanent changes often associated with peribronchial fibrosis begin to take place This type of patient is prone to repeated attacks of broncho pneumonia which may masquerade as exacerbations of chronic bronchitis Pyrexia and tachycardia are often absent by normal standards so that the diagnosis is only made radiologically Before the advent of the sulphonamides such attacks often killed a patient but now adays he may survive a dozen which have been treated by peni cillin Bronchiectasis may be discovered in patients of any age the oldest case known to the writer being 87 and having a history of bronchitis for over forty years

It is usually stated that the sputum in bronchiectasis separates into three layers The uppermost of these is froth the middle one fluid and the lowest contains a heavy deposit in which Dittrich s plugs leucocytes and crystals can be found During the past three years it has been customary for my bronchitic patients to spit into glass measuring cylinders so that their daily output can be measured conveniently These cylinders show three layers in the sputum of both bronchitis and bronchi ectasis but not those described in the text books The top layer is frothy varying in amount even up to four fifths of the total The second is composed of mucus muco pus or even frank pus in certain cases of bronchiectasis This may amount to seven eighths of the total but seems to be less in simple chronic bron chitis usually making up a third of the matter expectorated Cases with dilated bronchi tend to show whitish green colour in [illegible]

[illegible] fluid with several solid particles suspended therein As a rule less than a third of the cylinder is occupied with this layer which may be almost absent in some cases The chief distinction between the naked eye appearances of bronchitis and bronchi ectasis as regards sputum are therefore the greater depth and more purulent character of the middle layer Streaks of blood may be fo [illegible] conditions

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is whiter, with perhaps a tinge of grey and having more mucus than pus The lowest layer is the smallest of the three, but deeper in bronchitis than in bronchiectasis It is composed of clear fluid with several solid particles suspended therein As a rule, less than a third of the cylinder is occupied with this layer, which may be almost absent in some cases The chief distinction [illegible]

may be found in both conditions

zone of the lung, died and an autopsy was performed The degree of emphysema was much less than had been suspected during life and no bullae of any size could be demonstrated by careful search

On the clinical side, emphysema *tends to alter and mask other* phenomena so that their physical signs are obscured Mr W C suffered frequently from chronic bronchitis During one attack, his behaviour became so strange that his doctor sent him to a mental observation ward as a suspected psychosis On physical examination, the clinical signs were those of emphysema and very loud rhonchi and sibili There was no impairment of percussion note, no detectable bronchial breathing and no localizing signs in the lung Yet an x ray of the chest revealed an area of consolidation at the right base. Treatment of the pneumonia cured the psychosis, which was of course toxic in origin

Emphysema may also obscure other diseases within the thorax J K was referred to the out patient department of St John's Hospital for treatment of chronic bronchitis Examination of his chest revealed only signs of emphysema, but there was a tachycardia present at rest No localizing indications were found X ray of this patient revealed tuberculosis at both apices, while the sputum was positive for tubercle bacilli

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clinician and the signs of disease within the thorax

Bronchiectasis

This condition is the second satellite of chronic bronchitis, according to Christopherson and Broadbent It was present in 15 of the 300 cases which came to autopsy and were described in Chapter III Sometimes it is quite unsuspected until dilated bronchi are found *post mortem* Occasionally it is expected but not found The physical signs may be masked by emphysema during life, so that Lipiodol bronchography is the only satisfactory mode of diagnosis In the early stages of chronic

bronchitis, the dilatation of the tubes may only be slight and temporary Later permanent changes, often associated with peribronchial fibrosis, begin to take place This type of patient is prone to repeated attacks of broncho-pneumonia which may masquerade as exacerbations of chronic bronchitus Pyrexia and tachycardia are often absent by normal standards, so that the diagnosis is only made radiologically Before the advent of the sulphonamides, such attacks often killed a patient, but nowadays he may survive a dozen which have been treated by penicillin Bronchiectasis may be discovered in patients of any age, the oldest case known to the writer being 87 and having a history of bronchitis for over forty years

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Broncho-pneumonia

Few patients with chronic bronchitis develop lobar pneumonia, while many have exacerbations which may become broncho pneumonia In the series of cases which came to autopsy, only four had lobar consolidation as the cause of death Broncho pneumonia was present to some degree in 30 per cent of the total number The point of great difficulty is to separate consolidation from a simple "flare up" of bronchitis As we have seen, the presence of emphysema can mask physical signs to such an extent that differential diagnosis on clinical grounds alone is almost impossible Radiology is the only safe guide The levels of temperature and pulse rate may be misleading, especially in elderly patients This can lead to procrastination which has fatal results

Pensioner J F, aged 85, suffered regularly each winter from chronic bronchitis One cold January he complained of cough and was admitted to the Infirmary of the Royal Hospital The *temperature (98 4° F) together with scattered signs in the lung*, did not seem to indicate any serious condition Two days later, the temperature was 101° and clear signs of patchy consolidation were found In spite of sulphonamides the patient went downhill and died within a few days On looking through the clinical notes after his death, it was found that the customary temperature of this man during health had varied between *96 8° and 97 4° F, so that what had been considered a* "normal" figure really indicated pyrexia

It must not be thought that every patient who has pyrexia will develop consolidation In some cases there is an association with bronchial spasm, in which the temperature falls when the wheezing is terminated An example of this is given by a Chelsea pensioner with whom I have often played bowls He had a *regular sequence of cough wheezing–fever in* the winter Injection of adrenaline relieved the spasm and the pyrexia always subsided within a few hours In one period of eighteen months, this man demonstrated the cycle broken by adrenaline *four* times, without developing broncho pneumonia

When consolidation has taken place, it can usually respond well to penicillin and sulphonamides During recent months an

attempt has been made to abort suspected or threatening attacks of broncho pneumonia by inhalations of penicillin aerosol in oxygen and carbon dioxide (5 per cent) This has been generally successful and has prolonged the lives of many patients If specific therapy is delayed the course of the disease is longer and general systemic or toxic manifestations may take place These are usually cardiovascular in nature and will be enumerated later One syndrome of general toxaemia, however, is worthy of description

In pensioner H A , aged 81, suffered from winter cough On examination he showed clinical signs suggesting consolidation in the left lung The temperature was only 98 2° F , the pulse 88 and the respirations 26 Sulphonamides were therefore not prescribed Two days later there was definite pyrexia and tachycardia After administration of sulphonamides the temperature fell but the pulse continued rapid and feeble The belly became distended and tympanitic and there was retention of urine After four days in this state, during which time brandy and carbachol were given to the patient, he recovered

This clinical picture was not unknown to earlier writers Since 1940, or thereabouts, it has become less common It may still be encountered occasionally in cases which do not respond completely to the administration of penicillin, and sometimes has a fatal outcome

Other pulmonary complications

Haemoptysis is not uncommon in cases of chronic bronchitis It seems to have little significance and the prognosis of the disease is not altered thereby The majority of patients with this system have a raised blood pressure, but a small number show normal tension A number of those with blood stained sputum have been followed up over a period of years and examined radiologically at intervals No special lesion is demonstrable by x ray, even while haemoptysis is still present No proven case of pulmonary infarct or thrombosis has occurred among those examined Several patients have shown blood repeatedly in the sputum at intervals of several months or years without evidence of any disease other than their bronchitis

From time to time, partial or complete collapse of a lung may be encountered in bronchitic sufferers The site is usually basal There may be no symptoms; on rare occasions the patient com plains of a dull deep pain Dyspnoea is sometimes increased The clinical signs of impaired movement, diminished vocal fremitus, dull percussion note and absent breath sounds at first suggest a pleural effusion Paracentesis produces no fluid, however, and radiology indicates collapse as the cause of the physical signs As a rule only a small portion of a lung is affected Occasionally the clinical signs are absent or doubtful and the condition is only revealed by x-ray The lung generally expands completely within a few days or weeks

In cases where there is marked emphysema, spontaneous pneumothorax may take place The usual mechanism is the rupture of an emphysematous bulla The signs and symptoms are the same as those produced by any other pneumothorax

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CHAPTER X

CARDIAC COMPLICATIONS OF CHRONIC BRONCHITIS

As WE have seen in our study of the morbid anatomy, some form of cardiac failure is the commonest termination of chronic bronchitis. The factors which cause this are partly cardiovascular and partly pulmonary in origin Their secondary results are briefly described in the chapter on clinical pathology. Anatomically, emphysema is probably the most important structural change, but atheroma of the aorta and coronary arteries also plays an important part In the older age groups, various forms of myocardial degeneration occur Consequently, there is a tendency to increasing strain on a heart whose muscle is becoming less efficient because of age, fibrosis, or impaired nutrition The frequency of the cardiovascular changes led Lord to consider that the basic pathology of chronic bronchitis was probably circulatory and not pulmonary in origin While our [illegible]

than it has received hitherto

Right ventricular failure

Congestive heart failure, with systemic oedema, was the cause [illegible]

emphysema, a large heart and the presence of oedema early in the nineteenth century. Perhaps the best account of the genesis of this condition has been written by Parkinson and Hoyle, who state "Certain chronic diseases of the lung may produce a secondary effect upon the heart with the production of what

has been variously termed pulmonary heart disease, cor pulmonale or emphysema heart " They go on to point out that there are parti
heart disease ·
tension, and ε
symptoms Hence several writers minimize the frequency of this condition, confusing *bronchitis with myocardial failure* However, the only test of cardiac failure in cor pulmonale is systemic oedema In the absence of failure, the test of cardiac involvement is enlargement of the heart Therefore the most satisfactory form of clinical investigation for such cases must be radiology Parkinson and Hoyle find that enlargement of the pulmonary conus of the right ventricle is a prominent feature in such patients Other findings which may be encountered are general enlargement of the right ventricle and, less often, of the right auricle The pulmonary artery is large and may show increased density at its bifurcation The left branches, which are usually prominent, may obscure the pulmonary arc It is the outflow tract of the right side of the heart which shows the earliest and the most marked changes radiologically The prominence of the left ventricle depends upon the state of the systemic blood pressure

The clinical signs of cor pulmonale are less clear-cut than the *radiological findings Enlargement of the right* heart may give rise to an epigastric pulsation, while distension of veins in the neck is often present The onset of cardiac failure is shown by the presence of oedema This may be extensive, especially in older patients Feet, ankles, thighs, hands and forearms may all be involved, while a sacral pad is common in bedridden patients One case allowed the fist to sink a full inch into the thigh, so great was the swelling In the writer's experience, enlargement ... n these cases

rhythm Owing to the presence of emphysema, it is ... possible to determine the position of the apex beat, nor the size

of the heart by percussion Auscultation usually reveals weak or absent sounds at the apex, with some accentuation or reduplication at the pulmonary base In addition to the normal trademarks of bronchitis and emphysema, there are cyanosis clubbing of the fingers, orthopnoea and over-acting accessory muscles of respiration, which go to complete the clinical picture Wood describes a characteristic high P wave in the electrocardiograph of anoxic pulmonary heart disease More valuable in prognosis is the expression of the face When the cheeks sag and fall in, when a greyish tinge is seen in the complexion, when the expression becomes apathetic, and the set of the mouth loosens, then a fatal termination draws nigh The course of failure in cor pulmonale is progressive to a fatal issue There are few patients who have even temporary recovery

Treatment

The researches of McMichael and Sharpey Shafer have shown that cardiac failure due to emphysema is characterized by a high venous pressure and a high cardiac output They suggest that these features are compensatory for the anoxia produced by the pulmonary changes Lowering venous pressure by venesection or the administration of digitalis is likely to be harmful Ferrer and his co workers, however, claim improvement following the use of intravenous Digoxin, and consider that chronic cor pulmonale may be reversible by adequate treatment Following McMichael, however, I have used ouabain [illegible]

patient will do well on 2 5 mg twice daily while the next will need 5 mg three times a day Best results are obtained by using the pulse rate as a guide, as cumulative effects do not seem to occur with this drug On ouabain patients seem to maintain a state of comparative equilibrium for several months, while many go steadily downhill when digitalis is administered The oedema can usually be lessened by the injection of mersalyl once or twice a week A raised blood urea is not a

130/80 Eventually he went into a coma with figures of 110/60, dying soon afterwards

In a series of 30 cases similar to that related above, bronchitis was the precipitating factor among 12 of them (37 per cent) The onset of delusions or nocturnal restlessness among aged patients should therefore always raise the diagnosis of cerebral ischaemia

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CHAPTER XI

TREATMENT I

Expectorant Drugs

PARIS defines expectorants as "medicines which are supposed to be capable of facilitating the excretion of mucus from the breast (*ex pectore*), that is, from the trachea and cells and passages of the lungs" This class of drugs has always tended to be a heterogeneous mixture, difficult to classify One division into stimulating and depressant persisted for some years, but was slowly abandoned More recently a text book of *Materia Medica* mentioned a reflex group, a group acting centrally, and one which stimulated the bronchial glands It has always been customary to employ expectorant drugs in the treatment of chronic bronchitis on an empirical basis One authority advises various combinations of ammonium carbonate, ammonium chloride, tincture of ipecacuanha, preparations of squills or senega, if the cough is troublesome and expectoration scanty Yet another writer considers "the so-called stimulating expectorants are worthless" This attitude of scorn and doubt goes back as far as Badham, who cannot think highly of the efficacy of expectorants 'One shall fail, then another, yet under the use of a third a patient shall be very sure that he is better It is true, that by the time he makes trial of the third, a natural period of relief may have arrived, still we must allow something to medicine"

The experimental results of Boyd suggest that many substances might increase the amount of matter expectorated Using lightly anaesthetized animals, and measuring the production of respiratory tract fluid, she finds that ammonium chloride, ammonium carbonate, ipecacuanha, camphorated tincture of opium, potassium iodide, creosote, oil of turpentine, oil of aniseed and terebene all increase the output Her methods and

conclusions have been criticized by Alstead, whose experiments on human beings indicated very different effects Measuring the sputum in 17 cases of chronic bronchitis, he tested potassium iodide and tincture of ipecacuanha Sputum increased in seven patients, diminished in eight and was unchanged in two, on iodide alone When ipecacuanha was added, there was an increase in two cases, a decrease in 14 and no difference in one A subsequent investigation on 31 subjects with ammonium chloride showed that sputum increased in eight patients, decreased in 13 and was unaltered in 10, as judged by weight In 15 who received ammonium carbonate, the amount increased in five, decreased in five, and remained the same in five Alstead also noticed that cases of chronic bronchitis were liable to show considerable fluctuation in the output of sputum during a control period This period lasted for a few days only, during which the patients were given coloured water instead of medicine Since these results seemed to be worth confirming and extending if possible, an investigation was undertaken by the writer

A series of cases was observed in a ward at St John's Hospital, Battersea Each man was provided with a large measuring cylinder, graduated in cubic centimetres, and was instructed to spit into it and into no other receptacle The cylinder was emptied twice daily after the levels of sputum and of froth had been recorded Charts were kept as a routine showing the daily and weekly amounts produced Thus the variations of sputum expectorated could be observed at a glance Altogether 26 patients took part in the various experiments, some only for a few weeks, others for as long as two years of continuous study All the cases were in the same ward under the same routine conditions and could thus stand comparison, one with another The two factors which were not under the control of the experimenter were the condition of the pathological lesion—i e , the degree of bronchitis—and the state of the weather These patients were what has been termed by Almroth Wright "autoproteric controls " Since they fulfil his criteria of being hopelessly chronic cases, they were the most satisfactory material for the investigations undertaken

The first experiment, illustrated in Fig 13, demonstrates the

variations in the daily amount of sputum when no medicine [illegible]

to the ounce It will be seen that, in the graph of the sputum output, the figure varies from 90 ml to 20 ml in the 24 hours

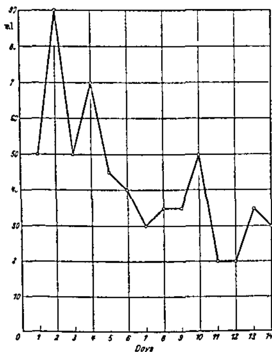
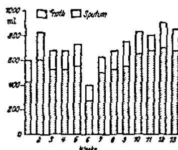
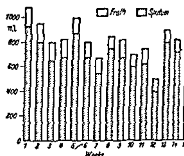


Fig 13—Output of sputum on water

Such differences indicate that great reserve is needed when interpreting the effects of administering drugs to produce or lessen expectoration

As an extension of this, several patients were put on coloured water for longer periods and their weekly output of sputum was recorded The variation between the various totals was





Figs 14 15 —Weekly output of sputum on water

considerable, even in the same subject at different times This i shown in Figs 14 and 15 There is often no clear trend but a unsteady rise and fall from week to week This finding agai makes it very difficult to take much notice of minor variation occurring when alleged expectorants are being given to a patient In Fig 16, the results from administration of a standard cougl mixture are followed by a period when only coloured water wa exhibited It will be seen that the output of sputum has an upward trend in the second part of the figure This would seen to suggest that at first sight the cough mixture lessened th

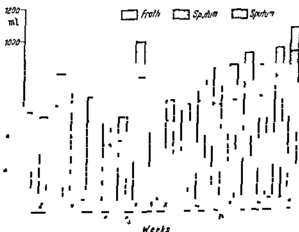


Fig 16 —Weekly output of sputum on cough mixture followed by water

amount of matter expectorated When the original records were examined more carefully, however, it was found that the change over took place during the month of November Some

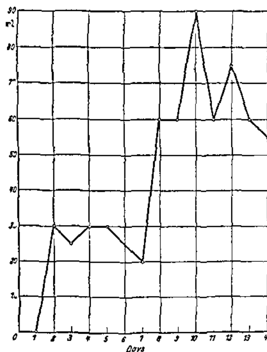


FIG 17 —Daily output of sputum on *Mist Ammon cum Senega*

of the increase in sputum, at least, can therefore be attributed to the onset of winter weather, not to the coloured water alone

[illegible]

no expectoration at all! Can such a mixture deserve the title

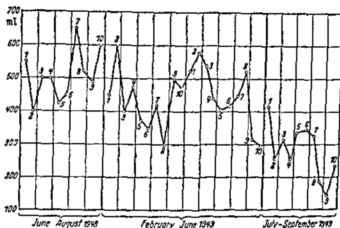


FIG 20 —Weekly output of sputum with certain drugs

1 Water
2 Camphorated tincture of opium 30 minims, three times a day
3 Extract of liquorice, 30 minims, three times a day
4 Ammonium carbonate, 10 grains, three times a day
5 Ammonium chloride, 20 grains three times a day
6 Tincture of ipecacuanha, 10 minims, three times a day
7 4 + 5 + 6
8 Emulsion of anise, 10 minims, three times a day
9 Sodium iodide, 10 grains, three times a day
10 Syrup of codeine phosphate, 60 minims, three times a day

example is given in Table X It shows results when the cycle of drugs tested was administered thrice successively without any break

It will be seen from Table X that the only drugs which consistently increased the amount of sputum each time they were administered are syrup of codeine phosphate, extract of liquorice and sodium iodide This experiment was carried out some twenty two times and there is little or no resemblance between one curve and another, even when repeated in the same patient as we have seen above Those preparations which increased the sputum in the subject mentioned above have not the same effect in other cases The amount of matter expectorated rises and falls in its own rhythm, unaffected by any of the drugs which were tested This is shown by the results tabulated in Table XI.

TABLE X—Weekly Sputum Output on Various Drugs (W E)

Drug	1st Cycle ml	2nd Cycle ml	3rd Cycle ml	Average ml
1 Water	410	390	190	330
2 Camphorated tincture of opium	380	240	200	273
3 Liquid extract of liquorice	440	270	490	400
4 Ammonium carbonate	610	190	360	387
5 Ammonium chloride	480	190	360	341
6 Tincture of ipecacuanha	390	220	420	343
7 4 + 5 + 6	360	240	260	287
8. Emulsion of anise	280	150	190	207
9 Sodium iodide	370	190	230	263
10 Syrup of codeine phosphate	390	200	270	287

TABLE XI—Variations in Sputum Summarized

Drug	Decreases	Increases	No Change	(Unknown)
1 Water	4	11	2	5
2 Camphorated tincture of opium	11	7	4	—
3 Liquid extract of liquorice	6	15	1	—
4 Ammonium carbonate	13	9	0	—
5 Ammonium chloride	12	7	3	—
6 Tincture of ipecacuanha	13	9	0	—
7 4 + 5 + 6	9	12	1	—
8 Emulsion of anise	12	6	4	—
9 Sodium iodide	6	12	4	—
10 Syrup of codeine phosphate	8	12	2	—

Depressant drugs

It has always been said that opium and its derivatives have a depressing action upon the cough reflex and tend to diminish the output of sputum This was tested experimentally in the cases under observation The results in four of the subjects are shown in Figs 21–24 The drugs employed were tincture of opium, diamorphine, camphorated tincture of opium and codeine phosphate, thrice daily with coloured water as a control It will be seen that the output of sputum on tincture of opium varies from 50 ml to 880 ml in a week Sometimes water produced more sputum than the depressant drugs, at other times it gave less There is not the clear-cut result which a pharmacological text-book would lead one to expect It would appear that these drugs have no definite action on the production of sputum

One small experiment was undertaken to investigate the effects of certain drugs on bronchial spasm During this the amount of sputum was measured each week as usual, since it was thought that some of the drugs might have an action upon the bronchial mucous glands No clear-cut effect upon the production of sputum was observed, except that aminophylline

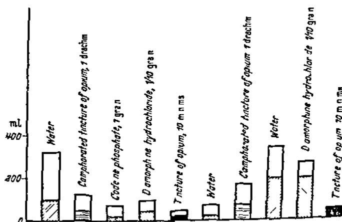


Fig 21 —Effect of sedatives on weekly sputum output

always produced more than pituitrin—its predecessor in the series This is shown in Table XII

Table XII

Weekly Sputum Totals in Experiment on Bronchial Spasm

Drug	Dose	Patient				
		W''	P	B	S'	E'
		ml	ml	ml	ml	ml
Atropine	gr 1/150 t i d	300	990	210	950	340
Ephedrine	gr ½ t i d	250	1 130	310	825	225
Tincture of belladonna	m 15 t i d	110	1 050	300	830	250
Carbachol	2 mg b i d	230	1 010	275	760	175
Pituitrin	5 units daily	290	960	260	825	240
Aminophylline	gr 1½ t i d	340	1 000	375	900	290
Physostigmine	gr 1/100 daily	260	925	360	860	400
Solution of adrenaline	¼ ml b i d	220	710	400	830	720
Pilocarpine	gr ½ t i d	330	690	750	750	450

NOTE Pituitrin physostigmine and adrenaline were given hypodermically

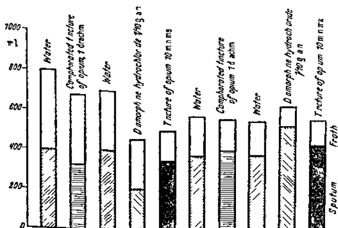


FIG 22—Effect of sedatives on weekly sputum output

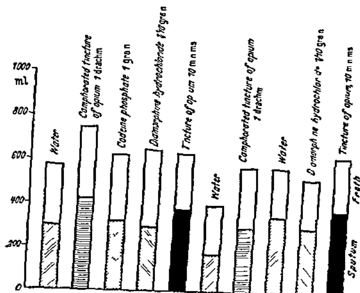


FIG 23 —Effect of sedatives on weekly sputum output

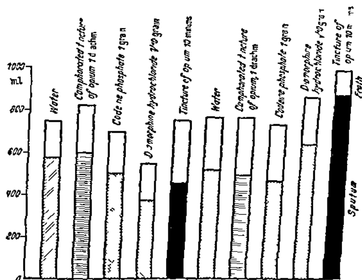


FIG 24 —Effect of sedatives on weekly sputum output

Summary

A number of the drugs commonly used in cough mixtures were tested as to their power to increase or diminish the output of sputum No consistent results were obtained Much the same variations were produced when coloured water was administered Compare Figs 25 and 26 for changes following clinical exacerbation and recovery

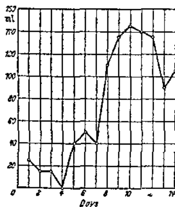


FIG 25 —Daily output of sputum during exacerbation of bronchitis

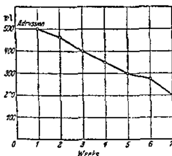


FIG 26 —Weekly output of sputum during recovery from bronchitis

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CHAPTER XII

TREATMENT II

Antispasmodics

SINCE one of the most distressing manifestations of chronic bronchitis is wheezing caused by bronchial spasm or narrowing, the effective treatment of this is important Not only will it give relief to the distressed patient, but it will increase the vital capacity as well in many instances In order to treat the condition, however, it is necessary to have some clear ideas about its mechanism In this connexion, the work of Segal and his colleagues is of great value They quote the findings of Ellis and Weiss, who produced a sensation of substernal constriction with some difficulty in inspiration and a slight dry cough in some normal men by intravenous administration of acetylcholine They also mention that Alexander and Paddock provoked asthmatic breathing by the subcutaneous injection of 3 mg of pilocarpine in certain asthmatic subjects I found that 1/12th of a grain of this drug administered by mouth three times a day to patients with chronic bronchitis was usually followed by an increased tendency to wheezing In some cases this caused such respiratory distress that its experimental use had to be suspended Acetyl beta methyl-choline is another drug which can give rise to bronchial spasm as shown by Starr, Villaret, Moll and other workers The same substance has also been proved to diminish the vital capacity by Hurtado and Kaltreider Segal and his co workers show the changes in vital capacity when an asthmatic subject inhales aerosols of histamine or Mecholyl Within three minutes it is only half the former level and does not return to normal until about twenty minutes have elapsed They utilize this fact to evaluate the therapeutic efficiency of various drugs as broncho-dilators From these findings it appears that either histamine or parasympathetico-

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mimetic drugs can produce asthmatic manifestations, including *bronchial spasm and a diminished vital capacity*

In the past, the approach to the problem of the relief of wheezing has been empirical Badham quotes Akenside as recommending ipecacuanha in asthmatic cases Paris, in the ninth edition (1843) of his *Pharmacologia*, includes extract of hyos cyamus in two model prescriptions for expectorants Fothergill advises cigars made with *Datura stramonium* "to smoke one or more of these often furnishes much comfort, from the relaxation of muscle fibres so produced" Mitchell Bruce, writing in 1899, mentions ether, chloroform, belladonna, lobelia or stra monium Even in 1941, Lee Lander considered stramonium to *be the most effective anti spasmodic Adrenaline has been used* in true asthma for a number of years, especially under the advice of Hurst Ephedrine, with its slower action, has also been employed extensively

Most of the remedies employed today fall into one of two categories They are either effective by opposing or depressing the activity of the parasympathetic nervous system, or they act by combating the results of histamine liberation Let us con sider a few points about the former group of drugs It has been customary for many years to prescribe mixtures containing a few grains of potassium iodide in combination with lobelia, gelsemium, hyoscyamus, belladonna or stramonium It has been my experience that small doses of such medicines were often ineffective I had a number of patients who continued to *wheeze their way into my* consulting room and who admitted only slight or moderate relief from the standard prescriptions of the National Formulary At the Royal Hospital, Chelsea, *during the war, I tried* [illegible] the dose of these antispasmodic d[illegible] [illegible]d to improve [illegible] Several cases of [illegible] an ima[illegible] kind [illegible] donna [illegible] been [illegible] pr[illegible]

infections Hence it is not possible to rely too much on drugs which act by paralysing the parasympathetic system

Turning from clinical experience to experimental medicine, we can review the results of Beakey, Bresnick, Levinson and Segal in the Department of Inhalation Therapy, Boston City Hospital They found that when 0 6 mg of atropine sulphate was given intravenously, it protected the subject against the bronchospastic effects of intravenous Mecholyl completely for two hours and partially for four hours afterwards Little protection was afforded against the production of asthma by histamine, however When Bellafoline was tested, the intravenous injection of 0 5 mg gave more protection against Mecholyl than did atropine Inhibition was complete for three hours and significant for at least six hours The bronchospastic powers of histamine were not affected by Bellafoline The use of Bellafoline in the form of an aerosol (0 05 per cent) gives little or no protection against intravenous Mecholyl When 0 5 mg is administered by mouth, there is a latent period of an hour, it then protects against Mecholyl for three hours Scopolamine in doses of 0 3 mg, hypodermically, counteracts the effects of Mecholyl for about four hours, whether this drug is given intravenously or as an aerosol If scopolamine 0 6 mg is given by mouth, there is a latent period of about an hour after which it is effective against Mecholyl for nearly five hours Given as an aerosol, its powers in this direction rapidly diminish There is little or no protection against bronchial spasm produced by histamine when scopolamine is used This appears to be a general rule for all the belladonna group of alkaloids On reviewing these results and their clinical applications, Segal and his co-workers had to admit that this group of drugs has a very limited application in cases with asthma or bronchial spasm occurring in other diseases The vagotonic element does not preponderate sufficiently to make them of practical value

Let us now turn to the anti histamine preparations It has been widely held that bronchial spasm in asthma or chronic bronchitis is due to the liberation of histamine from its usually bound state in the tissues On the hypothesis that this might be so, I used Benadryl in cases of chronic bronchitis with spasm,

both alone and in combination with aminophylline by mouth My experience has been that Benadryl does relieve many of the more obstinate cases, but it has a marked tendency to cause drowsiness (I have personal knowledge of this matter, having employed the drug while suffering from hay fever, where I found it superior to ephedrine) The combination of aminophylline with Benadryl seemed clinically to be the most efficacious type of oral therapy for routine purposes in patients with persistent spasm

When we turn for confirmation to the experimental field, we find that Herxheimer has shown Phenergan and Anthisan to be effective in suppressing bronchial spasm induced by histamine, acetyl-beta-methyl-choline and certain allergenic extracts Severe attacks of genuine asthma could not be so controlled, however His best clinical results were obtained by using

of protection against histamine induced, and to a lesser extent methacholine induced, dyspnoea and bronchial spasm Their poorest results occurred in elderly patients with chronic pul-

action was the same, but the degree of protection was definitely greater Inhalations of 1 4 per cent aerosol gave only slight

was a peak of effectiveness lasting four hours at a high level against histamine and two hours at a lower level against Mecholyl The other drug tested, Pyribenzamine gave very similar results The conclusion reached is that anti histamine drugs given by the rectal route, either alone or combined with aminophylline can maintain patients free from bronchial spasm in many cases Administration by aerosol combined with a

broncho-dilating drug is also often effective Parenteral injection should only be employed for acute spasm

There remain to be considered certain drugs which relieve bronchial spasm and wheezing, but which do not belong to the groups mentioned above One of the most efficacious of these is aminophylline In my clinic this has come to be the favourite for general use When doses of 3-4½ gr are used by mouth, it seems to be well tolerated and without the unpleasant side-effects of ephedrine It is also suitable for intravenous or intramuscular injection where necessary In bronchitic patients showing cardiac manifestations, aminophylline seems to benefit the heart as well as the bronchi The drug can be employed in conjunction with Benadryl with good results as mentioned above Segal's experiments show that 0 5 g of aminophylline intravenously results in immediate protection against bronchial spasm from either histamine or methacholine lasting over two hours Rectal administration of the same dose gives a similar result after about an hour's delay Oral use is much less effective, while 25 per cent aerosol inhalation or intramuscular injection has feeble protective powers On the other hand, Charlier and Phillipot report that inhalation of a 10 per cent solution of aminophylline has a definite pneumodilator effect, even in the face of carbachol A solution of 2 25 per cent adrenaline used in the same way had a result better than this while a comparable prevention of bronchospasm could be obtained with aerosol of 4 per cent Aleudrine (*isopropylnor*adrenaline) These authors mention that when the aerosol solutions were made up with 12 5 per cent polyvinyl pyrrolidone in water the pneumo-dilating actions of adrenaline and other drugs were increased and prolonged They also found that inhalation of a 2 per cent aerosol of the drug Parparnit had a powerful action against bronchial spasm induced by carbachol

The Boston City Hospital workers have also compared the efficacy of adrenergic agents used for the relief of bronchospasm They found no consistent differences whether the drugs were administered intravenously or as aerosols The most powerful agent found was 0 5 ml of 1/1000 adrenaline solution The tachycardia and other side effects proved too disagreeable to

CHAPTER XIII

TREATMENT III

Antibiotics

WHEN penicillin was introduced into our therapeutic armamentarium, it was found to produce good effects in lobar pneumonia if administered by intramuscular injection Since the bacteriology of this disease is not very unlike that of chronic bronchitis, a similar line of treatment seemed to be indicated Yet, in practice, it had poor results Investigation by Segal and his co-workers demonstrated that penicillin by the intramuscular route is not excreted in the sputum, but seems to leave the body mainly via the urinary tract Under these conditions some form of inhalation therapy was the obvious approach to treatment of chronic suppurative conditions of the respiratory tract In 1946 Humphrey and Joules published their results of penicillin aerosol therapy After studying 80 patients, they found that Gram positive cocci disappeared rapidly from the sputum after a period of four days Cough became easier and less frequent within two days, which gave great relief Sputum was diminished in amount, getting more mucoid and less purulent Any pyrexia subsided quickly and the temperature sometimes fell dramatically Dyspnoea was decreased, while blood sedimentation and white cell count returned to normal Concurrent with these clinical changes went improvement of the radiological appearances This report suggested that a really effective cure of chronic bronchitis had at last been found

After seeing the cases which Humphrey and Joules had treated, I started to use this method of treatment on my own patients I found that while inhalations of penicillin aerosol gave beneficial results during acute exacerbations of the disease, they had no very great effect in the other phases True, the bacteriology of the sputum was altered considerably Streptococci

and pneumococci were removed, but only to be replaced by such organisms as *B Friedlander*, *M Catarrhalis* and *H influen ae*, If oxygen and 5 per cent carbon dioxide were used instead of air to vapourize the solution of penicillin, improved ventilation of lung bases seemed to occur Yet a daily total of 200,000 units for two weeks did not prevent the return of chronic manifesta tions of the disease in a series of six patients A similar series of six, not treated by this method, differed little clinically or radio logically from those who had been the subject of experiment at the end of a fortnight These results agreed with those of Southwell at Guy's Hospital in the main, particularly as regards the bacteriological changes Since this time, aerosol therapy has been confined to periods in which there are acute exacerbations It has been successful in preventing the onset of broncho pneumonia on a number of occasions In the treatment of that condition, doses of 80,000 units five times during the 24 hours gave the best results The dose is dissolved in saline before being placed in the inhaler, of which there are several patterns That which I mainly used was produced by Moore, of Aberdeen, and was connected by a rubber tube with a cylinder of oxygen A pressure of 5 lb per square inch was necessary for good results, anything less than this being inefficient. A period of ten [illegible]

varieties of machine for administering aerosols The Collison inhaler, issued by the Inhalation Institute, Eccleston Square, S W allows two separate therapeutic substances to be employed at the same time Aerosol Products Ltd, Wigmore St, W 1, have an Aerolyser driven by an electric motor, which forces air through the nebulizing phial This does not allow the use of oxygen and carbon dioxide, however, in conjunction with the drug employed Riddell Products Warwick St, W 1, have recently introduced a hand pump type of inhaler which can be used in the home of the patient, without the need for electric connexions or cylinders of oxygen This is much less fatiguing to work than the type with a hand bulb as its motivator, which can cause cramp in a feeble person There seems to be some

evidence that the addition of a proportion of glycerine to the water in which drugs like penicillin are dissolved before use in a nebulizer increases the duration of action of the antibiotic On the other hand, solutions which are too viscid will not break up into particles which are sufficiently small to be passed through the kind of apparatus described above

Experimental investigation of this form of treatment has shown that about 10 per cent of the penicillin is lost within the apparatus Some 48 per cent enters the recesses of the lungs and 29 per cent is inactivated within the body Only 5 per cent is excreted in the urine When drugs like penicillin are adminis tered as aerosols, good blood concentrations may be found for a period of two hours after inhalation Higher concentrations in the sputum (15 per cent) can be obtained if the drug is intro duced directly into the trachea as a solution Local anaesthesia is necessary, however, if this method is employed as a form of therapy This results in temporary loss of the cough reflex which is undesirable Since a cannula is required for the intro- duction of the solution, damage may be done to the larynx by repeated instillations Hence this technique of intratracheal enicillin does not seem suitable for the routine treatment of uch conditions as chronic bronchitis or bronchiectasis in spite f the claims of Metras and Lieutier On the other hand, it has much to commend it as a pre operative measure when surgery is contemplated Another development on similar lines has been the introduction by Abbott Laboratories (and other firms) of apparatus allowing the inhalation of penicillin in the form of a fine dust This is stated to allow a wide dissemination in both upper and lower portions of the respiratory tract

There have recently been reports of aerosol therapy with a combination of penicillin and streptomycin This appears to diminish the Gram negative organisms as well as those sensitive to penicillin Olsen has claimed good results with 10 000 units of penicillin and 50 000 of streptomycin per ml using 3 ml to be nebulized each hour In some cases the sputum of his patients was reduced as much as 75 per cent Aureomycin seems to pro- mise even better results when available Collins claims to have improved cases with acute exacerbations of chronic pulmonary

The relaxing quality of the climate is particularly suited to bronchitic patients in winter Generally speaking, the north and east parts of this country are unsuited for cases of chronic bronchitis, as are any cold, damp or foggy areas But there is much difference between towns even a few miles apart For example, many patients say that their chest is not helped by living at Brighton, but that Worthing, only ten miles away, suits them very well Central London, Sheffield and Liverpool have a bad reputation for bronchitis, and should be avoided by those who are afflicted with this disease

It is customary to advise light clothing for bronchitic patients My experience has led me to wonder whether such people are not unduly sensitive to cold They certainly tend to amass layer upon layer of garments, with a predilection for those made of wool and flannel Removal of clothing merely seems to make them uncomfortable and the physician unpopular If the oral temperature be taken, it will be found on the low side of normal in some patients, figures of 97°, 96° or even 95° F not being unusual A series of 50 Chelsea pensioners had their mouth temperature taken for exactly one minute The results for those suffering from chronic bronchitis were below 95°, 96°, 95 8°, 95°, 95°, 95 2°, 96°, 96 4° At the end of five minutes the figures had risen to 96 4°, 98 2°, 97 6°, 96°, 96 8°, 96 2°, 97 6°, 97 4° The ages of these men varied from 71 to 87 Their figures were generally lower than the average for 326 healthy pensioners, which was 97 81° after five minutes in the mouth

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clogged with sputum Properly designed exercises often assist the expectoration of mucus and help to clear the bronchi The range of movement in the joints of the thorax is also increased, so that the vital capacity is improved In addition, deep breathing ventilates the whole of the lung and opens up alveoli previously blocked by secretion The basic exercises are composed of chest shaking, chest vibration and clapping given to loosen the sputum I have found that the most effective form of vibration is that carried out by an electric vibrator, using a vulcanite or plastic rotating disc which can be applied to various parts of the chest This is followed by shoulder raising and lowering, circle turning, side bending, trunk twisting and back raising Active muscular work is completed by an exercise with a long inspiration and a long expiration, during which the chest is gently shaken by the patient or the physiotherapist Relaxation must also be taught and attention paid to body posture Further details may be found in text books of physical medicine Short wave diathermy has been used on an experimental basis at St John's Hospital, Battersea It was initiated following the discovery of a reference to this form of treatment in the bronchitis of small domestic animals, such as lap dogs The electrodes are laced in an anterior and posterior position, not laterally, to btain the best results Periods of treatment start with five or n minutes of gentle heat and gradually increase to forty inutes It is best to take the sensations of the patient as a ude to temperature for there are wide variations from case to case Most of those who have had this form of treatment improved, one man being without wheezing for a period of five months It has been customary to give a course of twelve treatments As a rule, the patient starts to feel the benefit after the second or third While this method cannot of course, be considered as curative in bronchitis, it is worth a trial as a subsidiary mode of treatment

Prevention of complications

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Other prophylactic measures sometimes recommended are vaccines and a course of general ultra violet light With regard to the former, the results are often disappointing even in those cases where the disease is kept active by a chronic sinus infection The latter seems to be more beneficial, but the effect is not prolonged The course of exposures should be repeated three or four times a year if the maximum results are to be obtained Other methods of physical treatment which can help in chronic bronchitis are breathing exercises and the use of short wave diathermy to the chest Many patients only use a portion of r lungs in normal respiration Their bases tend to become

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accumulation of sputum in the bronchial tubes and with the periodic exacerbations of inflammation within the lung Thus, measures to aid expectoration may do something to prevent its occurrence As we have seen in the chapter on expectorant drugs it is very doubtful whether the ordinary cough mixture is of value in this respect What then are we to do? First place should probably be given to breathing exercises, as mentioned above Next comes postural drainage In practice it is very difficult to get elderly patients to carry out this form of treatment, as they say that it makes them feel giddy or uncomfortable Younger

often produces a fairly large expectoration This is the real virtue of the famous "hot water mixture," Mist Sodii Chlor Co But similar effects follow half a pint of hot water, a mug of tea or any other drink In order to produce expectoration it has been my practice to use hot water alone, first thing in the morning and last thing at night, in my bronchitic patients If the practice be discontinued for some reason, the patients themselves say that they miss the effect of their hot drinks

The prevention of exacerbations of bronchitis, which may turn into broncho-pneumonia, is not always an easy task It is difficult to recognize the early signs of such an attack Generally speaking, there is no rise of temperature in the early stages, nor is the pulse rate accelerated The two signs which may act as a guide are an increased respiration rate and an alteration in the posture of the patient from his customary mode of sitting or lying Physical signs in the chest are obscured by emphysema at first By the time that they are well developed, areas of con-
Hence the general

aborted by inhalations of penicillin aerosol, vaporized with oxygen and carbon dioxide to promote vigorous breathing Generally speaking it is not necessary to supplement this with sulphonamide drugs or injections of antibiotics In a feeble

patient, however, it may be safer to give a short course of sulphathiazole or sulphamerazine as well The expectation of life in cases of chronic bronchitis with some dilatation of their tubes has been extended several years since these methods of treatment became available

The other measure which is important as a method of preventing complications is the suppression of useless cough Each act of coughing in a lung which is the seat of emphysema promotes further damage to the tissues If some of the smaller tubes are blocked with viscid secretion, the strain on the remainder will be increased Gradually more and more of the pulmonary vascular bed will become obliterated until the oxygenation of the blood and the outflow from the right ventricle alike are impeded Thus the less frequent and violent the cough, the better for the patient Much coughing arises from habit or irritation in the pharynx Hence attention should first be directed to these points The motto for cases of bronchitis should be Spit by day and sleep by night The avoidance of cold fog, dust and penetrating winds is one step towards this In particular, going into a cold, draughty bedroom at night must be avoided Provision of a fire or a radiator to heat the atmosphere before the patient goes to bed will prevent that paroxysm of coughing which prevents him from getting off to sleep in comfort The next point is administration of a sedative mixture to be taken when actually in bed The two principal ingredients should be bromide and an opiate This is designed to decrease the cough reflex sensitivity and to diminish the tendency to cough from sheer habit It is not supposed to diminish the expectoration Such preparations as Linctus diamorphine B P C, or Linctus scillae opiatus may be used if the functional element is not pronounced The customary dose of these medicines, however, (one drachm) is too small to provide effective cough sedation in many cases of chronic bronchitis Two drachms of Linctus diamorphine or three of Linctus scillae opiatus may be necessary In my opinion, the doses of opium derivatives employed in cough mixtures are often too small to achieve their purpose My experience has been that it is sometimes necessary to use up to one grain of codeine phosphate, or a tenth of a grain of

diamorphine hydrochloride, or ten minims of tincture of opium, or a drachm of camphorated tincture of opium, or fifteen minims of tincture of chloroform and morphine to obtain the desired results These doses are usually without danger

A patient entered the consulting room of a doctor in Chiswick and complained of a violent cough There were few signs to be found, except for a red, inflamed pharynx The doctor therefore dispensed six ounces of a mixture containing five minims of tincture of chloroform and morphine to the half-ounce dose He then continued with the routine of his evening surgery Just as he had finished, he was surprised to see the same patient come into the waiting room once more "What do you want?" he asked "Another bottle of that medicine," was the reply "My wife and I have finished the lot It was grand!"

In cases of this sort, where the inflammation of the upper respiratory tract is the origin of the trouble, it is better to have the assistance of an experienced otolaryngologist Nose drops containing ephedrine and inhalations of steam containing compound tincture of benzoin or menthol can often improve the clinical condition If the infection starts to spread down into the larynx or trachea, the question of aerosol therapy will need consideration Certain patients who have recurrent upper respiratory tract infections are sometimes helped by local ultra violet light Others benefit from short-wave therapy to their sinuses On the whole, the results obtained from administration of vitamins are rather disappointing So is the effect of vaccine treatment In fact, it seems easier to attack an established infection than to prevent it

Generally speaking, in spite of the recent advances in therapeutics, chronic bronchitis is not an easy disease to combat The physician must be prepared to treat the patient as a whole and not just his pathological condition Bronchitic sufferers need a "guide, philosopher and friend" to advise them more than most of mankind They are unsuitable for penny in the slot medicine The condition from which they are ailing still has its unsolved mysteries awaiting further investigation Hence it is a field in which care, consideration and clinical acumen will be rewarded time and again

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